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UNITED STATES
ENVIRONMENTAL PROTECTION AGENCY
REGION V

[illegible]
230 S DEARBORN ST.
CHICAGO, ILLINOIS 60604

MAY, 1978

ENVIRONMENTAL
IMPACT STATEMENT

DRAFT

COMPLETED
ORIGINAL

# DETROIT WATER POLLUTION CONTROL SYSTEM : SEGMENTED FACILITIES

## DETROIT, MICHIGAN

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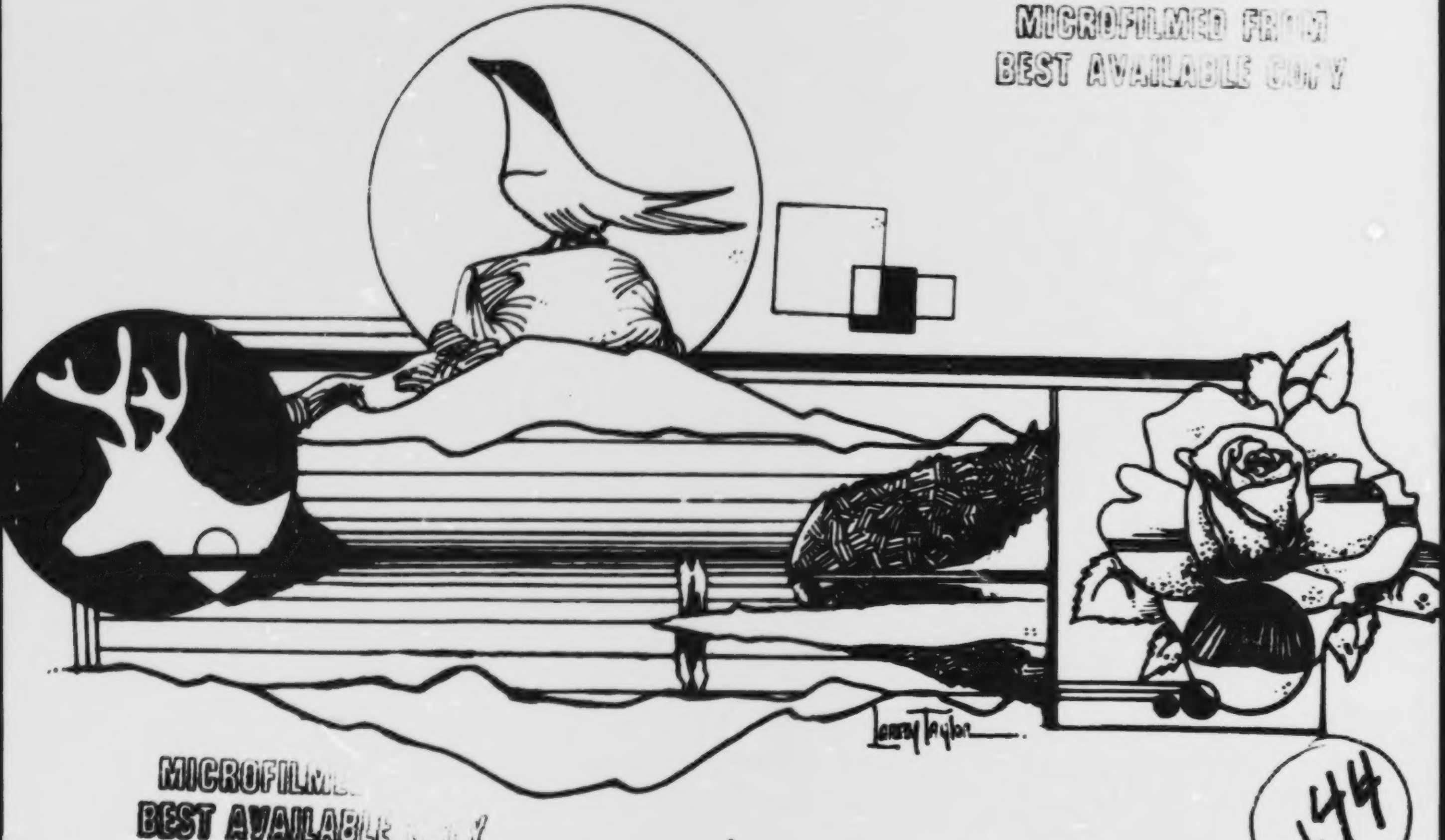

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# DRAFT ENVIRONMENTAL IMPACT STATEMENT

# DETROIT WATER POLLUTION CONTROL SYSTEM:

# SEGMENTED

# FACILITIES PLAN

PROPOSED BY

DETROIT WATER AND SEWERAGE DEPARTMENT

Prepared by the

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION V, CHICAGO, ILLINOIS,

DETROIT WATER AND SEWERAGE DEPARTMENT

DETROIT, MICHIGAN,

AND

ECOLSCIENCES, INCORPORATED

SOUTHBEND, INDIANA

APPROVED BY:

Valdas V. Adamkus

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U.S. Environmental Protection Agency

John P. Kanters
Director, Detroit Water
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May 1978

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TO ALL INTERESTED AGENCIES, PUBLIC GROUPS, AND CITIZENS:

This Draft Environmental Impact Statement (EIS) represents a major step in providing for the adequate treatment of wastes generated, conveyed and treated within the Detroit Water and Sewerage Department's service area. The scope of this Draft EIS is the provision of service in the service area up to a daily average flow of 1050 million gallons per day. Contained within a Consent Judgment reached in Federal District Court are specific dates for the attainment of secondary treatment. This document has been factored into the planning process providing each agency a common frame work from which future decision making can be made. The information contained within this document is provided to allow public participation prior to final decision making and implementation by the involved parties. The recommendations presented in this document are not binding on any agency at this point.

Any decision on further expansion of the existing system into the outlying areas of Oakland and Macomb Counties beyond the existing service area has been deferred at this time. Treatment capacity and facilities for combined sewer overflows excluding relief work necessary within the City of Detroit will be addressed in a separate EIS. The U.S. Environmental Protection Agency is also recommending that the construction of the North Interceptor-West Arm be deferred until the final facilities plan and its corresponding EIS are prepared.

Both the U.S. Environmental Protection Agency and the Detroit Water and Sewerage Department jointly issue this EIS and seek your comments.

Sincerely yours,

Valdas V. Adamkus

Valdas V. Adamkus
Deputy Regional Administrator

John P. Kanters, Director
Detroit Water and Sewerage
Department

## FOREWORD

The environmental impact statement (EIS) was prepared within the guidelines established in U.S. EPA Program Requirements Memorandum 75-31. As a "piggyback" EIS, it relies on data presented in the draft overview plan and the draft segmented facilities plan for the Detroit Water and Sewerage Department by the joint venture of Giffels Associates and Black and Veatch of Michigan. References to the Draft Overview Plan with Environmental Assessment are given (Giffels/Black and Veatch, 1977, Book X). References to the segmented facilities plan, entitled Segmented Facilities Plan for the Detroit Water and Sewerage Department, are given (Giffels/Black and Veatch, 1978, Book X). The Segmented Facilities Plan (SFP) contains the following documents:

Executive Summary

| | |
|---|---|
| Book I | Summary Report |
| Book II | Description and Characteristics of Area - Volume 1 of 4<br>Land (DOA101)<br>Water(DOA102)<br>Air (DOA103) |
| Book III | Description and Characteristics of Area - Volume 2 of 4<br>Living Organisms (DOA104) |
| Book IV | Description and Characteristics of Area - Volume 3 of 4<br>Land (DOA106)<br>Human Interest (DOA107)<br>Infrastructure (DOA108)<br>Community Facilities (DOA109) |
| Book V | Description and Characteristics of Area - Volume 4 of 4<br>Population and Social Characteristics (DOA110)<br>Economic Conditions (DOA111) |
| Book VI | Air and Water Quality<br>Ambient Air Assessment (AWQ101)<br>Water Quality - Present and Future (AWQ4) |
| Book VII | Existing Waste Collection and Treatment Facilities - Volume 1 of 3<br>City of Detroit - Wastewater Collection System (WCT201)<br>Evaluation of Detroit Wastewater Collection System (WCT103)<br>Suburban Wastewater Collection System (WCT107)<br>Industrial Waste Discharges (WCT104) |

| | |
|---|---|
| Book VIII | Existing Waste Collection and Treatment Facilities - Volume 2 of 3<br>Background Information (WCT211)<br>Wastewater Characteristics (WCT112)<br>Existing Unit Processes (WCT213)<br>Assessment of Existing Facilities Performance (WCT114) |
| Book IX | Existing Waste Collection and Treatment Facilities - Volume 3 of 3<br>Sludge and Grease Incineration (WCT106)<br>Solids Disposal (WCT119)<br>Bound Assessment (WCT120) |
| Book X | Infiltration/Inflow Analysis (I/I101) |
| Book XI | Proposed Facilities - Volume 1 of 3<br>Detroit Collection System Alternatives (WCT8)<br>Suburban Collection System Alternatives (WCT9) |
| Book XII | Proposed Facilities - Volume 2 of 3<br>Preliminary Alternatives - Wastewater Treatment Processes (WCT15)<br>Sludge and Grease Incineration Alternatives (WCT106)<br>Solids Disposal Alternatives (WCT119) |
| Book XIII | Proposed Facilities - Volume 3 of 3<br>Comparative Wastewater Collection and Treatment Costs (PF101) |
| Book XIV | Environmental Assessment (EA) |
| Book XV | Legal - Institutional Relationships and Regulatory Requirements (LII201) |
| Book XVI | Public Participation (PP1) |

West Arm Segmented Facilities Plan - 2 Volumes (WA-SFP)
West Arm Segmented Facilities Plan - Environmental Assessment - 2 Volumes (WA-SFP-EA)

Copies of the Segmented Facilities Plan are available for review at the following locations:

Detroit Public Library
Main Branch
5201 Woodward at Kirby
Detroit, Michigan

Harper Woods Library
19601 Harper
Harper Woods, Michigan

Detroit Public Library
Downtown Branch
121 Gratiot at Farmer
Detroit, Michigan

Macomb County Library
County Service Center
Mt. Clemens, Michigan

Detroit Public Library
Reference Branch
1004 City-County Building
Detroit, Michigan

Southfield Library
26000 Evergreen Road
Southfield, Michigan

DWSD
Water Board Building
735 Randolph
Detroit, Michigan

Dearborn Library
16301 Michigan
Dearborn, Michigan

SEMCOG
1249 Washington
Detroit, Michigan

Giffels Associates
243 West Congress
Detroit, Michigan

# ACRONYMS

| | |
|---|---|
| CBD | Central Business District |
| CFR | Code of Federal Regulations |
| CSO | Combined Sewer Overflow |
| DRI | Detroit River Interceptor |
| DRI-R | Detroit River Interceptor - Relief |
| DWF | Dry Weather Flow |
| DWSD | Detroit Water and Sewerage Department |
| DWWTP | Detroit Wastewater Treatment Plant |
| EIS | Environmental Impact Statement |
| Encotec | Environmental Control Technology, Inc. (consultants) |
| EPA | Environmental Protection Agency |
| FWPCA | Federal Water Pollution Control Act |
| GLBC | Great Lakes Basin Commission |
| IJC | International Joint Commission |
| MDNR | Michigan Department of Natural Resources |
| MPN | Most Probable Number (ref. bacterial count) |
| NEPA | National Environmental Policy Act |
| NI-EA | North Interceptor - East Arm |
| NI-WA | North Interceptor - West Arm |
| NPDES | National Pollution Discharge Elimination System |
| OBERS | Office of Business Economics & Agricultural Research Service |
| O&M | Operation and Maintenance |
| O-NWI | Oakwood Northwest Interceptor |
| O-NWI-R | Oakwood Northwest Interceptor - Relief |
| OP/EA | Overview Plan with Environmental Assessment |
| SEMCOG | Southeast Michigan Council of Governments |
| SFP | Segmented FAcilities Plan |
| WA-SFP | West Arm - Segmented Facilities Plan |

# GLOSSARY

| | |
|---|---|
| Anoxic | Describes an environment devoid of oxygen; also anaerobic. |
| Benthic | The habitat at the bottom of a lake or river. |
| Chironomid | The immature form of a group of flies known as midges, who spend their pre-adult stages in the bottom or benthic habitat of rivers and lakes. |
| Copepods | A microscopic group of crustaceans that make up part of the free-swimming animal population in lakes known as the zooplankton. |
| Colonial Ciliates | Ciliates are a group of protozoans (one-celled primitive animals) that have specialized, movable hairs called cilia covering the outside of their cell membrane; colonial refers to a group of these ciliates living together. |
| Diatom | A microscopic, free-floating aquatic plant (algae) with cell walls of silica that is common in freshwater. |
| Disaggregated | The process of dividing regional population forecasts to create smaller political or geographical units forecasts. |
| Eutrophication | The process of nutrient enrichment of a body of water and its associated physical, chemical, and biological changes. |
| Fauna | The animal life in a region or environment. |
| Flora | The plant life in a region or environment. |
| gcd | Gallons per capita per day. |
| Macrophytes | Large aquatic plants whose growth patterns may be either floating, submergent, or emergent. |
| Oligotrophic | Describes a body of water with a small supply of nutrients and hence a low level of organic production (i.e. algae, macrophytes, invertebrates, fish). |
| Periphyton | Small aquatic plants (algae) which attach themselves to a substrate but do not penetrate, as would a rooted plant. |

| | |
|---|---|
| Pickle Liquor | Refers to liquid ferrous chloride, $FeCl_2$, a waste product of steel processing that is used in chemical phosphorus removal processes. |
| Salmonids | Refers to the salmon family, Salmonidae, and includes salmon and trout species. |
| Sessile | Refers to an organism's immobility; i.e., they live attached to an object, fixed in place. |
| Sphaerid | Refers to the genus Sphaerium, a small freshwater bivalve or clam. |
| Urban Heat Island | The phenomenon of heat absorption and retention that occurs in an area dominated by buildings and concrete surfaces, such as large cities. Heat is retained longer than in non-urban areas and affects the local climate, particularly precipitation and air currents. |
| Zoobenthos | That community of animals whose habitat is the bottom of a body of water. |

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# SUMMARY

(x) Draft Environmental Impact Statement
( ) Final Environmental Impact Statement
U.S. Environmental Protection Agency
Region V
Chicago, Illinois

1. Name of Action
   Administrative (x)
   Legislative ( )

2. The applicant's proposed action involves federal financial assistance for the upgrading and expansion of the existing Detroit Wastewater Treatment Plant (DWWTP) to a capacity of 1050 million gallons per day (mgd). The proposed action also includes expansion of the associated collection system. Federal financing is requested under the statutory authority of the Federal Water Pollution Control Act Amendments of 1972 (PL 92-500).

   The facilities planning consultant estimates that the proposed action will cost $514 million. Average annual operation and maintenance costs of the facilities are estimated at $36 million.

3. The recommended plan proposes that the existing regional wastewater treatment plant be upgraded to provide for optimum operation of facilities. Plant capacity would be sufficient to treat an average daily flow of 600 mgd with a 48 hour sustained peak flow of 1050 mgd. The plant will continue to use activated sludge to provide secondary treatment and ferrous chloride or another chemical to precipitate phosphorus in the primary or secondary clarifiers. Sludge processing will continue to include vacuum filtration of raw sludge followed by incineration. Final disposal of the fly ash in various landfill sites is recommended.

   The recommended plan also outlines changes which will be required to improve operation and maintenance procedures. Included are financing and management changes as well as modifications to existing contracts and ordinances.

4. The majority of the environmental impacts of the plan are related to the construction process. No major construction project can be undertaken in an urban setting without some disruption to the local residents. The construction impacts will be localized near the plant and at the access points of the tunnel interceptors.

   Sludge processing will have major impact on the environment. The incinerators will meet stack emission standards and reduce the plant's contribution to the air quality problems in the region. Because of its size, the landfill site will be a major impact, but mitigating measures can greatly reduce the severity of these impacts.

5. Information used in this EIS was solicited from federal, state, and local agencies as well as the public and local organizations. A list of parties receiving a copy of the Draft EIS is listed in Section 9.0 of this document.

## 1.0 INTRODUCTION

The purpose of this chapter is to set the stage for the reader. Included are the history of the facility, discussions of legal actions, explanation of legislation and regulations, description of the major issues, and outline of the study process, and a description of the public and governmental participation.

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# 1.0 INTRODUCTION

## 1.1 Background

### 1.1.1 Identification of Grant Applicant

The grant applicant is the Detroit Water and Sewerage Department, a department of the City of Detroit, Michigan. The department has been known by various names during its existence including Detroit Department of Public Works, the Detroit Department of Water Supply, and the Detroit Metropolitan Water Department. In this document, all three are referred to as DWSD.

### 1.1.2 Study Area Description

The study area was divided into two parts: the facilities plan study area and the overview study area. The division was made to provide a detailed facilities plan for the City of Detroit and a overview study of the suburban jurisdictions provided sewer service by the City of Detroit.

The facilities plan area (Figure 1.1-A) consists of the City of Detroit. The overview study area includes parts of Wayne, Oakland, and Macomb Counties, Michigan. The overview study area includes 78 autonomous political jurisdictions ranging from villages to counties (Section 2.9.1).

## 1.2 Legislation and Regulation

### 1.2.1 Facilities Planning & NEPA

Title II, Section 201 (g) (1) of the Federal Water pollution Control Act Amendment of 1972 (PL 92-500) authorizes the U.S. Environmental Protection Agency (EPA) to be the administering agency for "Grants for Construction of Treatment Works". This program allows the U.S. EPA administrator to provide financial assistance to any state, municipality, intermunicipal agency, or interstate agency for the construction of publicly owned water pollution control facilities. To secure federal assistance, the grant applicant must prepare a "Facilities Plan" which is partially funded under the U.S. EPA Construction Grants Program. The goal of this program and other provisions of PL 92-500 is to restore and maintain the chemical, physical, and biological integrity of the waters of the United States.

The National Environmental Policy Act of 1969 (NEPA) and Executive Order 11514 of March 5, 1970 entitled "Protection and Enhancement of Environmental Quality" require that all Federal Agencies prepare an environmental impact statement (EIS) for all Federal actions significantly affecting the quality of the human environment or being highly controversial.

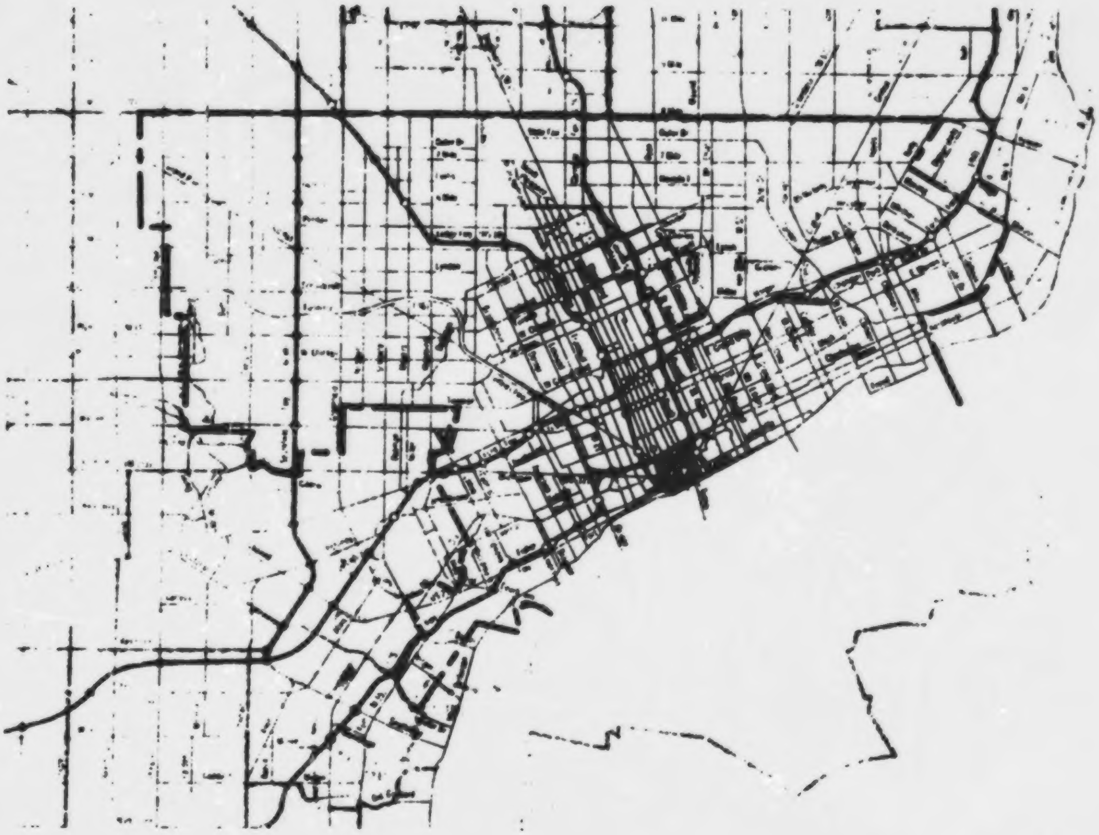

Figure 1.1-A
Facilities Planning Area
City of Detroit

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U.S. EPA is required to evaluate each proposed facilities plan and determine if the proposed action is expected to have a significant environmental impact or be highly controversial. Should an EIS be required, U.S. EPA Program Requirements Memorandum (PRM) 75-31 (formerly Program Guidance Memorandum 58) (U.S. EPA 1976 A) provides for the joint preparation of an environmental impact statement and the facility plan. This process is called "piggybacking". The piggyback process was developed to reduce the total time required, identify the significant issues and resolve the issues in a prompt manner, while satisfying all statutory requirements.

### 1.2.2 NPDES Permit

Section 402 of Title IV, Public Law 92-500, requires U.S. EPA or certified states to issue permit under the National Pollution Discharge Elimination System (NPDES). An NPDES permit limits the type, and amount of discharge of any pollutant. Civil penalties, monetary and penal, are required for violations of the permit. U.S. EPA has certified MDNR to issue NPDES permits within the State of Michigan.

MDNR issued an NPDES permit to DWSD for the DWWTP (Permit MI-0022802) in December, 1974. The NPDES permit contained interim effluent limits while expansion and upgrading of the DWWTP was being completed. Within the requirements of the NPDES permit a facilities plan was required to meet the final effluent limitations and the goals of PL 92-500.

## 1.3 History of the Facilities

### 1.3.1 Facilities Planning

The Detroit Department of Public Works in 1935 received a grant of $20,000,000 from the Federal Public Works Administration to construct a wastewater treatment plant. Completed in 1940 at a cost of $22,635,000, the facilities were turned over to the Department of Water Supply in 1941. At this time primary treatment and disinfection were provided, with wastewater discharge to the Detroit River. Between 1954 and 1966 additional modifications were made (Giffels/Black and Veatch, 1977, Book VIII).

In 1965 the facilities were transferred to the Detroit Metropolitan Water Department. A regional watershed pollution control program was begun in 1965 with a commitment to upgrade the water quality of the Detroit River and Lake Erie. During 1966, the City of Detroit and the Michigan Water Resources Commission reached an agreement to further limit the pollutants in the effluent. This agreement was amended in 1971 (Giffels/Black and Veatch, 1977, Book XV).

In accordance with the requirements of the construction grants program and the DWSD NPDES permit, a facilities plan was prepared and submitted in December, 1975 for DWSD by the engineering firm of Hubbell, Roth and Clark. The facilities plan was segmented to accelerate design and construction of various elements. As a planning document, the facilities plan was rejected by the regulatory agencies (MDNR and US. EPA) because of changes in regulatory requirements. However, some segments of the plan had previously been approved.

The failure of the facilities plan prepared by Hubbell, Roth and Clark to be approved and the repeated violation of the interim effluent limitations caused MDNR to revoke the DWSD NPDES permit on July 23, 1976. The revocation of the permit was conditional upon terms contained within the MDNR Final Order No. 1780. If the terms of the final order were violated, the penalties required by the NPDES permit would be invoked.

The Final Order required submission and approval of the required Facilities Plan by August 15, 1977. Within Final Order 1780, a list of mandated work was presented. The mandated work included: (1) facilities under construction, or under contract to be constructed and (2) contracts currently scheduled but not awarded for construction. The mandated construction includes the following elements:

1. Facilities under construction, or under Contract to be constructed:

   PC-283 Aeration Tanks No. 3 and 4 and Intermediate Lift Pumping Units (Fall, 1977)
   PC-284 Four Final Tanks (Summer, 1977)
   PC-288A Oxygen Plant (Fall, 1979)
   PC-294 Six Sludge Thickeners (Fall, 1978)
   PC-299 Sedimentation Tank Flow Control Improvements (Summer, 1977)
   PC-400 Sludge Complex I Improvements (Summer, 1980)
   PC-406 (Summer, 1978) and PC-408 (Spring, 1979) Four Final Clarifiers (Each Contract)
   PC-407 Four Primary Tanks Renovation - Group I (Fall, 1978

2. Contracts which are currently scheduled, but not awarded for construction:

   PC-276 Primary Tanks A3 and A4 (Spring, 1979)
   PC-295 Sludge Complex III (Spring, 1980)
   PC-413 Instrumentation Service Contract (Fall, 1977)
   SC-01 Operation and Maintenance Manuals
   CS-801 Site Improvements
   CS-802 Tall Stacks
   CS-804 Employee Service Building
   CS-805 Electrical System Renovation

PC-000 Computer Maintenance Contract
CS-813 Interim Sludge Disposal
-- Primary Tanks Renovations Groups II and III
CS-816 Grit Removal System Improvements

A new facilities plan was prepared for the City of Detroit during 1976-1977 by the joint venture of Giffels Associates and Black and Veatch of Michigan. Included in the document is a facilities plan for the City of Detroit, an overview plan for the suburban service area and an environmental assessment. This document, Overview Plan with Environmental Assessment (OP/EA), was developed as a master planning document for DWSD. In addition to the OP/EA, it was determined by the U.S. EPA that due to several major issues, an invironmental impact statement (EIS) would be prepared by U.S. EPA, Region V. In order to more rapidly arrive at a solution to the City of Detroit's problem, a "piggyback" EIS was implemented. The "piggyback" EIS was to be prepared concurrently with the OP/EA. A "Memorandum of Understanding" between U.S. EPA, the City of Detroit, the Board of Water Commissioners, and the Michigan Department of Natural Resources (MDNR) was written to describe the purpose of the project and the procedures to be followed (U.S. EPA, 1976A; U.S. EPA, 1976B).

During the organization of the OP/EA, it was decided by DWSD to prepare a segmented facility plan for the West Arm Interceptor that had previously been in the planning phase. A rapid analysis was to have allowed processing of Step 2 and Step 3 grant applications for fiscal year 1978. However, problems arose during the study that affected the timely completion. The lack of prior measurements caused problems in determining the dry weather flows and infiltration/inflow from the suburbs. Drought conditions during the fall and winter were such that combined sewer overflows (CSO) did not occur, making analysis of the CSO problem impossible. Detailed analysis of alternatives demonstrated that the proposed interceptor was not the only feasible solution to the problem of sewage overflows to the River Rouge. Consequently, further study was required, causing a disruption of the accelerated schedule. The Segmented Facility Plan for the West Arm Interceptor (WA-SFP) remained a separate document, but was submitted with the OP/EA. A hearing for the OP/EA was held on June 30, 1977.

PL 92-500 requires that the applicant, in this case the City of Detroit and DWSD, has or will adopt a system to pay for the local share of the services provided (user charge system). During the periods of 1974-1977 it became apparent to MDNR and U.S. EPA that DWSD would not be able to implement a user charge system. DWSD attempted to create a user charge system, however suburban jurisdiction brought suit to halt any increases in service charges. As a result, it became apparent that DWSD would be unable to provide the needed funds for the required construction. Without the local share funds available or assured MDNR and U.S. EPA cannot make grants for the requested facilities.

### 1.3.2 Legal Suit and Consent Judgment

As a result of DWSD'S financial situation and the operation and maintenance of the existing facilities U.S. EPA and MDNR determined that the City of Detroit and DWSD were not making satisfactory progress towards solving their problems, and began action to assure compliance by the City. Consequently, on May 6, 1977, a civil suit was filed by U.S. EPA and MDNR against the City of Detroit and DWSD to restrain them from violating their NPDES permit. The suit called for: (1) establishing a system of charges for the operation and maintenance of the treatment; (2) measures to be taken to attain maximum operational efficiency and pollution control; and (3) imposition of a civil penalty in the amount of $10,000 per day for violations of the NPDES permit (U.S. District Court, 1977A).

The conjuction with the civil suit, negotiations for a Consent Judgment were begun to avoid a lengthy public trail. The Consent Judgment details the changes necessary in the existing system in order to reach compliance with the NPDES permit, provides a schedule of necessary equipment construction, and requirements for recruitment of qualified personnel to operate the treatment plant.

Major items addressed in the Consent Judgment include (U.S. District Court, 1977B).

- Development of immediate financing, user charge, industrial cost recovery, and local capital cost funding systems;
- Enforcement of city and federal industrial pretreatment regulations;
- The operational, maintenance, and staffing changes that are necessary;
- The completion of the facilities plan; and
- A description and scheduling of interim and permanent sludge disposal procedures.

The Consent Judgment was agreed to by all parties on September 14, 1977. The Consent Judgment is included in this EIS as Appendix 11.8.

## 1.4 Proposed Action (Summary)

### 1.4.1 Description

The primary finding of the SFP was that if the existing facilities were properly operated and maintained, relatively few modification would be required to assure compliance with the NPDES permit and air quality standards. The SFP recommended that the mandated Sludge Complex III and the tall incinerator stacks, currently under contract, are not needed and should not be constructed.

#### 1.4.1.1 Treatment Facilities

Optimization of existing facilities is the alternative recommended for action. This action includes continued construction of the secondary treatment facilities plus rehabilitation of pump/grit units and controls, flow metering devices, primary sludge pumping and piping, final clarifiers, chlorine feed systems, secondary filtered effluent system, solids handling system, vacuum filters, incinerators, and polymer and ferrous chloride systems plus supplementary ferric chloride feed.

#### 1.4.1.2 Collection System

Collection system construction within Detroit would be for the relief of combined sewers during stormwater conditions. Construction in the suburban collection system would include Mt. Clemens Arm, and parts of the Lake Shore and Richmond Arms (Figure 1.4-A). Additionally, interceptor reliefs as proposed by the facilities planning consultant.

#### 1.4.1.3 Residual Disposal

Residuals include treatment plant sludge, grit, screenings, and scum and grease. The proposed action recommends continuation of the present disposal methods for grit and screenings (landfill), and scum and grease (incineration and landfill of ash).

Incineration is recommended for processing of the sludge, with ultimate disposal of the ash in landfills. The capacity of upgraded Sludge Complexes I and II when completed in 1981, will be able to accommodate the sludge produced from dry weather flows through year 2000, when incinerator (contract CS 400) modifications are completed.

#### 1.4.1.4 Management

In order to satisfactorily maintain and operate the treatment plant, certain management changes are recommended as grant conditions for DWSD. A definition of the chain of command within DWSD is necessary to ensure proper operation

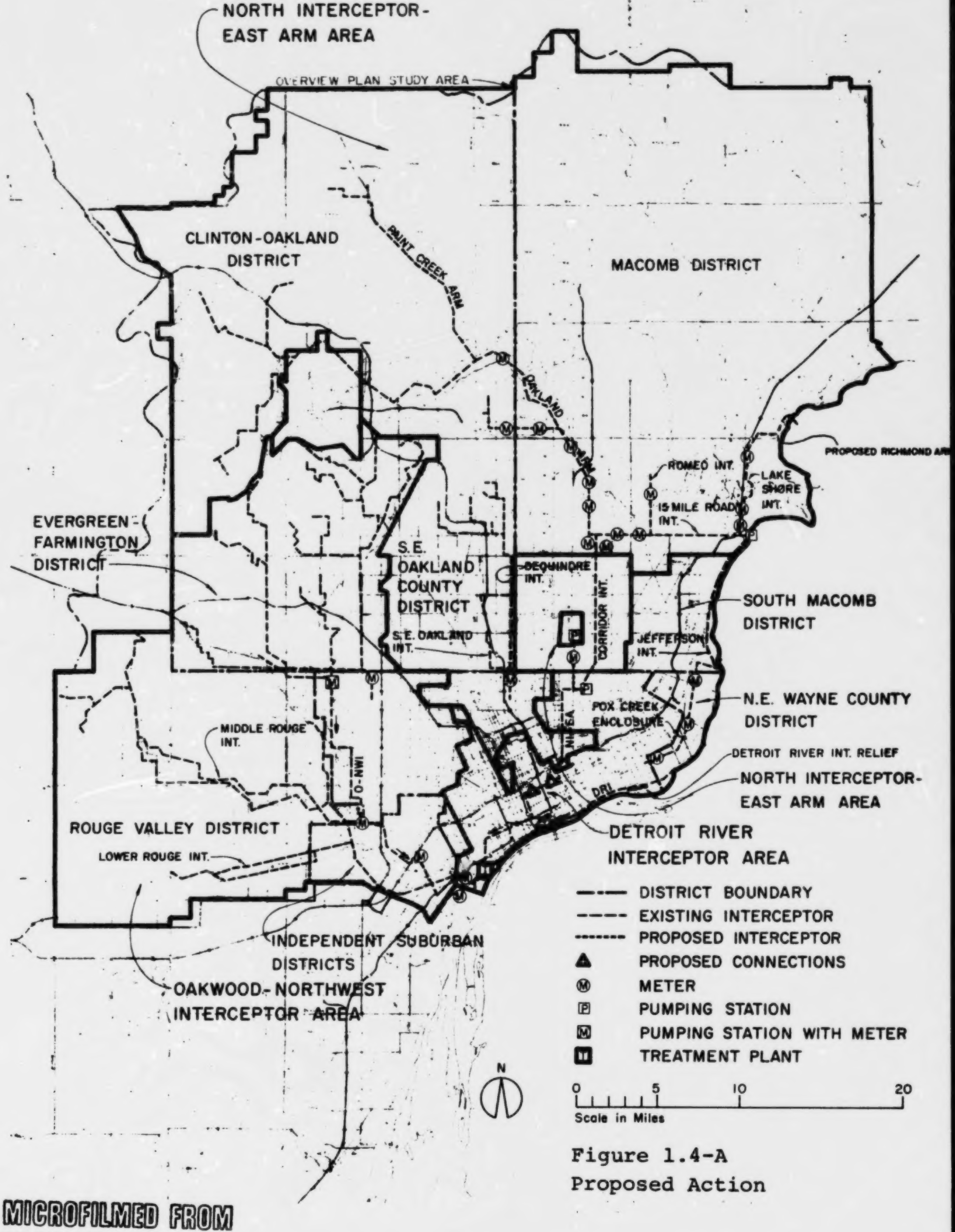
NORTH INTERCEPTOR-EAST ARM AREA
OVERVIEW PLAN STUDY AREA
CLINTON-OAKLAND DISTRICT
PAINT CREEK ARM
MACOMB DISTRICT
OAKLAND ARM
PROPOSED RICHMOND AR
ROMEO INT.
LAKE SHORE INT.
15 MILE ROAD INT.
EVERGREEN-FARMINGTON DISTRICT
S.E. OAKLAND COUNTY DISTRICT
DEQUINDRE INT.
CORRIDOR INT.
SOUTH MACOMB DISTRICT
S.E. OAKLAND INT.
JEFFERSON INT.
N.E. WAYNE COUNTY DISTRICT
FOX CREEK ENCLOSURE
NI-EA
MIDDLE ROUGE INT.
O-NWI
DETROIT RIVER INT. RELIEF
NORTH INTERCEPTOR-EAST ARM AREA
DRI
ROUGE VALLEY DISTRICT
DETROIT RIVER INTERCEPTOR AREA
LOWER ROUGE INT.
INDEPENDENT SUBURBAN DISTRICTS
OAKWOOD-NORTHWEST INTERCEPTOR AREA
DISTRICT BOUNDARY
EXISTING INTERCEPTOR
PROPOSED INTERCEPTOR
▲ PROPOSED CONNECTIONS
Ⓜ METER
P PUMPING STATION
M PUMPING STATION WITH METER
TREATMENT PLANT
N
0 5 10 20
Scale in Miles

Figure 1.4-A
Proposed Action

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of sewerage systems. Adequate staffing at the plant, and the training of treatment plant operators must be upgraded to provide the necessary level of skill to properly run the system. The ongoing training program will partially satisfy the need for skilled employees. The procurement system for parts must be changed to allow for rapid repair of machinery. These changes would facilitate proper operation and maintenance of the treatment plant.

#### 1.4.1.5 Legal and Institutional

It is recommended that suburban contracts be renegotiated to reflect the actual needs of the communities and the capacity of the treatment plant. This would allow better control over industrial flows and the development of cost recovery and user charge systems.

### 1.4.2 Air Quality Problems and Objectives

The DWWTP is located in the highly industrialized area of southwest Detroit. This area is currently experiencing a serious suspended particulate air quality problem. In 1975, the annual average particulate concentration at Station 05 was 131 $ug/m^3$ as compared to the standard of 75 $ug/m^3$. This station is the closest to the plant site and is approximately 1.5 miles to the northeast. For the 24 hour particulate concentration Station 05 exceeded the primary standard 6.7% of the time and exceeded the secondary standard 35% of the time.

The main air quality goal in the area is the attainment of the primary air quality standards. The MDNR has completed an analysis of the area to determine if the state implementation plan is sufficient to ensure compliance by 1985. The MDNR report concluded that neither secondary nor primary standards would be achieved in the areas of Wayne County which are now violating the standards. However, significant reductions in ambient suspended particulate levels will occur in the heavily industrialized downriver area (Air Pollution Control Commission, 1976). The goal of the SFP is to meet stack emission standards.

### 1.4.3 Water Quality Problems and Objectives

Overall water quality within the study area ranges from fair to poor. Water quality objectives for this project are to meet secondary effluent discharge limitations and to reduce combined sewer overflows, particularly to the River Rouge.

### 1.4.4 Residual Disposal Problems and Objectives

The present residual disposal system uses contract hauling of incinerator ash, screenings, and a portion of the grit.

The hauler has the responsibility of selecting a state approved ultimate disposal site. The DWSD does not have control of the sites that are used or of the management conditions at the sites. Also, occasionally incineration of the sludge is imcomplete, resulting in a product that is not totally inert (Giffels/Black and Veatch, 1977, Book IX).

The objective of this study is to identify the alternative which will provide a disposal system with minimal environmental impacts, is compatible with the treatment process, is cost-effective and can be implemented.

### 1.4.5 Financing the Project

The Consent Judgment requires an equitable user charge system. An increase in user charges was implemented by DWSD on September 1, 1977. However, litigation initiated by the suburbs has restricted collections. Regardless, the most pressing issue facing DWSD is the attainment and continuation of collecting sufficient revenues to implement the needed and mandated construction.

On October 19, 1976, the President signed PL 94-558 which authorizes the Administrator of U.S. EPA to guarantee loans by the Federal Financing Bank to U.S. EPA grantees. The loans may be used to finance the local share of the cost of wastewater treatment works and the Administrator of U.S. EPA must certify the grantee cannot obtain sufficient credit on reasonable terms to finance its actual needs without the guarantee and that there is reasonable assurance of repayment. Current U.S. EPA regulations do not allow DWSD to utilize this method of financing.

Under PL 92-500 the Environmental Protection Agency Construction Grants Program finances 75% of the allowable costs for the collection and treatment of wastewaters for communities. The State of Michigan, through the Water Resources Commission, administers a grant program providing 5% of the allowable costs. The municipalities involved must finance the remaining 20% of the allowable costs and all of the nonallowable costs.

To finance portion of the Consent Judgment, the Federal Court Judge on September 9, 1977, reserved $347,000,000 of the PL 92-500 funds allocated to Michigan for Detroit (Giffels/Black and Veatch, 1977, Book I). Subsequent legal action reduced the Detroit share to $77,000,000. The 1977 amendments to PL 92-500 allocates $150,000,000 per year for fiscal years 1978-1980 to fund water pollution abatement programs.

## 1.5 Study Process

In accordance with Federal regulations, the Notice of Intent and the Memorandum of Understanding the EIS process was designed to coordinate with the facilities planning process. Interim reports and analysis systems were reviewed by U.S. EPA. At key decision points, such as the development and selection of alternative, interagency meetings including U.S. EPA, MDNR, and the Southeastern Michigan Council of Governments (SEMCOG) were held to ensure U.S. EPA participation in the decision-making process.

During the preparation of the EIS, the OP/EA interim reports, the OP/EA report and the SFP reports were used as a basis for information. Limited additional information was collected for use in the EIS and was made available to the facilities planning consultants. During analysis of the alternatives developed for the OP/EA, joint meetings were held to accelerate transfer of ideas. However, the EIS maintained a separate analysis of the alternatives. The analysis of the alternatives was a two part, three phase analysis. The collection and treatment analysis was divided from the sludge analysis to reduce the complexity of the analysis. Each of the two parts were subjected to a three phase analysis which: (1) identified possible components of the system and its subsystems, (2) combined the system components into alternatives for screening to determine the feasible alternatives and (3) evaluation of the feasible alternatives to arrive at the recommended plan.

In order to facilitate coordination, a number of meetings on specific topics were held. On January 12 and 13, 1977, a workshop was held which was attended by DWSD, the facilities planning consultants, and EIS consultants. During the workshop, the progress to date of the OP/EA was presented, and discussions of the expected direction and procedures to be used occurred. Problem areas were identified and possible solutions discussed. Issues concerning population forecasts, land application, and sludge handling were resolved.

On February 15, 1977, a meeting was held to discuss the approach to secondary impacts that was to be taken. Attended by DWSD, U.S. EPA, and the facilities planning and EIS consultants, the degree of secondary impact to be expected was discussed. As a result of this meeting, the definition of the "no action" alternative was formulated.

Several meetings were held on alternatives. On February 3, 1977, the consultants met to discuss the treatment plant process alternatives. On March 24 and 25, 1977, DWSD, U.S. EPA, MDNR, the facilities planning and EIS consultants met in Detroit to discuss the feasible alternatives. Conceptual alternatives presented by the facilities planning consultant and justification for decisions on screening were discussed. Additional alternatives presented by MDNR, U.S. EPA, and their consultant were taken into consideration by the facilities planning consultant. On May 6, 1977, the progress toward a selected plan was presented by the facilities plan consultant for review and comments by MDNR, U.S. EPA, DWSD, and the EIS consultant.

On April 14, 1977, a meeting was held by U.S. EPA with members of both consultants, MDNR, SEMCOG, and staff from various departments of Michigan State University. This meeting discussed the OP/EA and EIS land application of sludge alternatives and the present views on heavy metal and nitrogen limitations.

These meetings resulted in U.S. EPA input at all decision-making levels. U.S. EPA was able to monitor the progress of the projects, identify problem areas, and assure that all issues were being addressed.

In addition to the specific topic meetings, periodic meetings were scheduled to allow a rapid exchange of ideas, knowledge, and views. Involved at various times and in different meetings were: U.S. EPA, the facilities planning consultant, DWSD, MDNR, SEMCOG, Wayne, Oakland, and Macomb County Officials, and the public. Three types of meetings were held: public, interagency, and 208 coordination.

Five public meetings were held. These meetings presented the status of the OP/EA and EIS studies. The public was urged to attend and raise questions or comment at the meetings. The topics of public interest were reviewed and answers, where possible, were included in the studies.

The first public meeting held November 17, 1976, at Cobo Hall in Detroit resulted in the following comments and concerns:

- Dust and noise from present construction at the treatment plant;
- Offensive odors from the plant on weekends;
- Extension of sewers into rural areas;
- Increased auto traffic from suburbs to city; and
- Possible changes in water quality standards.

The second public meeting held on December 18, 1976, in Cobo Hall provided progress updates and conceptual alternatives. Public concerns expressed were:

- Odors from the plant on weekends;
- Possible expansion of the plant;
- Method of operating satellite plants;
- Control of sewer overflows;
- Possible construction of separated sewers in areas presently served by combined;
- Funding of local share;
- Possible use of a sludge disposal method other than incineration; and
- Routings of construction vehicles.

In order to ensure suburban input into the OP/EA and EIS studies, the next three meetings were held in different suburban locations. The third meeting was held in Dearborn Heights on February 23, 1977. The discussion of this meeting focused on service to the River Rouge area, and the West Arm Segmented Facilities Plan. Areas of public concern were:

- The possibility of enclosing or paving more of the River Rouge; and
- Sewer overflows.

On March 30, 1977, a meeting was held at the Macomb County Court House. The basic alternative approach being used for analysis of collection and treatment alternatives and the sludge disposal alternatives was discussed. Comments from the public expressed interest in:

- Continuance of suburban contracts with DWSD; and
- A regional authority.

The meeting held in Southfield on April 28, 1977, discussed the feasible collection and treatment alternatives and the sludge disposal alternatives. The types of sewerage authorities possible were also discussed. Concerns of the public were:

- The need for a regional authority;
- Satellite plants at Connors Creek;
- Control of overflows; and
- Sludge quality affecting land application.

Interagency meetings involved, at various times, representatives from SEMCOG, and Wayne County Air Pollution Division, as well as U.S. EPA, the facilities planning and EIS consultants, MDNR, and DWSD. Six meetings were held (October 20 and November 11, 1976, January 21, February 18, March 25, and May 6, 1977) during which the progress to date, problems encountered, processes used for analysis and issues to be covered were discussed. Issues discussed during these meetings included:

- Sewer overflows;
- Satellite treatment plants;
- Sludge disposal;
- Air quality problems;
- Service to suburban communities;
- Changing the facilities to physical/chemical processes;
- Energy conserving incineration;
- Phosphorus limitations;
- Authority alternatives;
- Population predictions;
- Effluent reuse; and
- Industrial wastes treatment.

In addition to meetings specifically for the OP/EA and EIS studies, U.S. EPA and their consultant have taken part in 208 coordination meetings. On May 16 and 17, 1977, meetings held at SEMCOG headquarters presented the OP/EA alternatives to the suburban communities and on May 18, 1977, a meeting was held to coordinate the Detroit Facilities Plan with the suburban plans. This was necessary because the DWSD system conveys and treats the sewage of suburban communities, and suburban facilities plans must base their selected plan on the DWSD constraints.

On June 7, 1977, the Draft OP/EA was published and a hearing scheduled for June 30, 1977, which was to be a joint OP/EA and EIS hearing. Prior to the hearing it was determined by the Regional Administrator of Region V, U.S. EPA that the OP/EA did not have sufficient information upon which to publish the Draft EIS.

The public hearing on the Draft OP/EA was held on June 30, 1977. U.S. EPA presented comments at that hearing. In addition, MDNR and DWSD raised various issues concerning the OP/EA. The issues centered around six issues:

- Extent of air pollution abatement to be included;
- Methods used for air quality modeling;
- Projected quantities of sludge;
- Location of the outfall;
- Extent of stormwater management, including the West Arm and Macomb County interceptors; and
- Plant layout and expansion.

During the months of July through November, 1977, meetings between agencies were held to resolve the issues. During these meetings it was concluded that the WA-SFP would be incorporated into the facilities plan. Conclusions and recommendations for CSO, stormwater management, and total residuals management could not be reached due to insufficient data. Therefore, it was decided to publish the segmented facilities plan by January, 1978, continue facilities planning for unresolved areas and print a final facilities plan by March, 1981.

## 1.6 Summary

PL 92-500 requires a facilities plan with environmental assessment during the planning process in order to determine the magnitude of the existing pollution problems, the cost-effective solution, and the timely construction of appropriate equipment. In early 1976, U.S. EPA determined there were significant issues present, and EIS was deemed necessary, and was implemented in a piggyback method. U.S. EPA input was required throughout the project, and was accomplished by review of the interim outputs of the facilities planning consultant and a series of meetings at decision points. Issues and problems were identified and selection of a recommended plan for certain tasks occurred with U.S. EPA's involvement. Additional studies were deemed necessary in order to adequately address various issues.

## 2.0 THE ENVIRONMENTAL SETTING

The following chapter describes current conditions within the study area including natural and man-made features. Sections discussed include natural and cultural resources, land use planning, population, and socioeconomics.

The data presented in the environmental setting is used to project the future situation. In later sections the future situation is compared with the recommended plan to determine what environmental impacts may result.

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## 2.0 THE ENVIRONMENTAL SETTING

The material presented in these sections is summary in nature and full discussions are contained in the SFP.

### 2.1 Climate

The climate of the study area is typical of the southern portion of the Great Lakes Region. Summers are warm and humid while winters are cold and cloudy with wide annual and day-to-day temperature fluctuation. Weather records are available from the Detorit City Airport and the Detroit Metropolitan Airport (Giffels/Black and Veatch, 1977, Book II). Two local features which significantly influence Detroit's climate are (1) the Great Lakes, and (2) the urban heat island.

The average temperatures range from 25.5°F (-3.6°C) in January to 73.3°F (22.9°C) in July. The average growing season is 180 days. Average relative humidity is normally between 70-80% with characteristically higher winter humidity.

Comparison of precipitation data from the two airports shows the influence of the urban industrial complex on precipitation measurements. Average annual precipitation is one inch less at the city airport than at the metro airport. Mean annual precipitation at the city airport is 30.96 inches (78.6 cm) and the annual snowfall is 31.7 inches (80.5 cm) from November through April.

The prevailing wind direction is generally from the southwest quadrant; however, southwest winds are more common at the metropolitan airport than at the city airport. The heat island and lake breeze effects may account for this difference. Wind speeds are greatest during the winter months and calm periods are more common during the summer months. Ninety percent of the 1975 wind speeds ranged between 4-16 knots.

### 2.2 Topography

Detroit lies within the Eastern Lake section of the Central Lowland Physiographic Province (Giffels/Black and Veatch, 1977, Book II). The present surface features are a result of glaciation. In the northwestern portion of the study area, hilly areas are separated by rolling to almost level plains. The nearly level formation in the southeast portion of the study area was created by glacial Lake Chicago.

Elevations also reflect the area's glacial history. A high point of 1221 feet above sea level is found in the hilly section of Oakland County, and a low point of 574 feet above sea level is along the Detroit River. Other than the western border of Macomb County, slopes greater than 12 percent are found only in Oakland County.

Stream drainage in the study area is meandering, characteristic of level areas with a uniform base material. In some areas the drainage has been modified by human activity such as channelization for flood prevention and control.

## 2.3 Geology

The bedrock underlying Detroit is composed of Paleozoic sedimentary rocks. Glacial drift covers the bedrock to a depth of 100 to 400 feet, although a few rock outcrops do occur in Wayne County (Giffels/Black and Veatch, 1977, Book II). Due to the amount of drift covering the bedrock, the study area is more influenced by the glacial materials than by bedrock.

Geologic resources that are economically important include sand, gravel, peat, clay, rock salt, lime, limestone and sandstone. Oil, natural gas and methane are also obtained from bedrock layers.

The sedimentary origin of the bedrock, the peat bogs and the water-laid glacial deposits are conducive to fossil preservation. Fossils have been found in the area.

The glacial deposits have not only modified the features of the landscape, they have also provided the predominant groundwater aquifer and the parent material for the soils of the area. Sands and gravels of the outwash deposits provide the best sources of groundwater, although limestone, sandstone and lenses of sand and gravel in the till are also used. A further reference on this topic is the Southeastern Michigan Water Resources Study Report Groundwater and Geology,1975,by F.R. Twenter, USGS, prepared in cooperation with the U.S. Army Corps of Engineers. It provides a time-scale and cross-section for the geologic layers and some groundwater data.

## 2.4 Soils

The soil types of the study area vary according to the land forms and parent material that they have developed upon (Giffels/Black and Veatch, 1977, Book II). Well drained, sandy and loamy soils are generally present on the hilly moraines of unsorted glacial drift in the northwest. On the more level till uplands and plains, poorly drained soils with finer textures are more common. Soils adjacent to the sand and gravel outwash plains have coarse to moderately coarse textures and range from being well drained to poorly drained. The soils of the lake plains in the southeast portion of the study area are usually poorly drained with textures ranging from fine through medium to coarse.

Soils suitable for septic tank disposal systems are found in each of the three counties, specifically, the upper three-fourths of Oakland County, the northwest quadrant of Macomb County, and the extreme northwest corner of Wayne County. The remainder of the area is unsuitable for septic systems due to low permeability and/or high groundwater tables.

Soils which exhibit high shrink-swell potential are limited in their use as a construction site. Some soils which are particularly high in clay content shrink in volume as they dry out and swell as they absorb moisture. "Extensive shrinking and swelling of the soil can result in damage to building foundations and concrete slab floors, and if extensive enough may rupture sewer lines." (Giffels/Black and Veatch, 1977, Book II).

In the study area there are soils with high shrink-swell potential concentrated along the shores of Lake St. Clair and the Detroit River. There is also an isolated area of these soils in northwest Wayne County (within the study area). For a graphic description of these soil locations see Figure 7 (Giffels/Black and Veatch, 1977, Book II).

Soils which have properties that allow high rates of permeability will likewise have limited use. These soils tend to be marginal for agriculture and can cause seepage and dewatering problems in open excavations during construction. Soils with high permeability dominate the study area. The major exceptions are those listed as high shrink-swell potential soils along the Detroit River and Lake St. Clair.

Some soils have properties, structural and otherwise, which will not allow support of extreme weights. Such low load-bearing capacity can be particularly attributed to the soil's compressibility or shear strength. These soils require special engineering practices to make them safe or even feasible for development.

The majority of soils in the study area that have low load-bearing capacity are within Wayne County. Other areas of their occurrence are isolated spots in Macomb County.

There are limited clay loam and clay soils in the area which have characteristics generally favorable for land application of sludge. Since smaller parcels of land are required for landfills than land application, the limited areas considered suitable for the latter alternative may provide some sludge landfill sites.

## 2.5 Hydrology

The study area lies within the Great Lakes Basin adjacent to Lake Huron and Lake Erie and comprises about 5 percent of the Lake Erie drainage basin (Giffels/Black and Veatch, 1977, Book II).

The principal waters draining the study area are Lake St. Clair, the Clinton River, the River Rouge, and the Detroit River which then flows into Lake Erie.

The major tributary to Lake St. Clair is the St. Clair River which lies north of the study area. Other tributaries to the lake are the Clinton, Sydenham, and Thames Rivers.

The Clinton River Basin covers the northern portion of the study area and has, as its main tributaries, the North Branch, Middle Branch, Red Run, Stoney Creek, and Paint Creek. The Clinton River watershed covers 741 square miles (1919.2 $km^2$). Lakes are interspersed throughout the northwestern section and act as natural reservoirs in the drainage system.

The flow from Lake St. Clair forms the Detroit River and is joined by the River Rouge before emptying into Lake Erie. The Detroit River is a 32 mile (51.5 km) strait connecting Lake St. Clair and Lake Erie and is the largest tributary to Lake Erie.

The River Rouge Basin includes the western and southern portions of the study area. The principal branches of the system are the Main Branch, Upper Branch, Middle Branch, Lower Branch, and Evans Ditch. The River Rouge drainage basin is fan-shaped and drains an area of 467 square miles (1209.5 $km^2$).

Flood prone areas which would be inundated by a 100 year flood have been mapped by the U.S. Geological Survey (Giffels/Black and Veatch, 1977, Book II). Certain quadrangles have not been completed, including sections of the Upper Rouge and the middle corridor of the Clinton River watershed in Macomb County.

Localized flooding in many instances around the City of Detroit, as part of the River Rouge floodplain, is attributed to inadequately designed sewer drainage facilities rather than flood stages on major streams.

### 2.5.1 Surface Water Quantity

Lake St. Clair is a shallow lake with a mean depth of 10 feet (3 m), a surface area of 430 $mi.^2$ (1113 $km^2$) and a volume of 1 $mi.^3$ (4 $km^3$). Flow through is rapid and mean water residence time is about 9 days (0.02 years) (Giffels/Black and Veatch, 1977, Book II).

Flow in the Clinton River from 1963 to 1973 averaged 530 cfs (15 $m^3/s$) and was approximately 0.3 percent of the Lake St. Clair overflow (the Detroit River source).

The mean flow at the mouth of the River Rouge (average 1970-1974) is 920 cfs (26 $m^3/s$). Natural flows from the drainage basin account for 270 cfs (8 $m^3/s$). The remainder of the river flow is mainly due to the Ford Motor Company discharge

(650 cfs, 18 $m^3/s$) located three miles upstream. This water is taken out of the Detroit River for industrial use and discharged into the River Rouge. This flow represents about 0.5 percent of the total Detroit River flow.

Flow in the Detroit River varies and is dependent on upstream and downstream lake level fluctuations, precipitation (which has been above average the past 10 years), and ice on the river. The main source of flow in the Detroit River originates from the upper Great Lakes drainage basin and thereby provides an ample supply for all water needs in the study area.

United States municipal effluent discharges, including the DWWTP, were estimated by the International Joint Commission (IJC) in 1975 to be 1500 cfs (43 $m^3/s$) or 1.0 percent of the river's flow.

Discharge from the Detroit River averages 190,000 cfs (5400 $m^3/s$) and contributes 80 percent of the inflow to Lake Erie. The greatest impact from the Detroit River is felt in the shallow western basin of Lake Erie (Giffels/Black and Veatch, 1977, Book II).

### 2.5.2 Surface Water Quality

Each major body of water is characterized in terms of only a few water quality parameters. Where current data is available the same parameters are discussed for each body of water. It is not always possible or necessary to maintain this consistency in presenting the current water quality. Other parameters are introduced as necessary to emphasize a certain water quality status or focus on a toxic element of public concern.

The major source of water (98.5%) into Lake St. Clair is high quality water from Lake Huron via the St. Clair River (Giffels/Black and Veatch, 1977, Book II). Influent from the Clinton River contains significantly higher concentrations of total phosphorus and dissolved organic carbon than does Lake St. Clair water (Ciborowski, 1975). The river also discharges water with lower amounts of dissolved oxygen and higher total alkalinity and free $CO_2$ than the lake water. Studies done by the IJC and MDNR in 1974 and 1975 concur that the source of poorest quality water into Lake St. Clair is the Clinton River. Six suburban wastewater treatment facilities with a total capacity of almost 60 mgd (227,100 $m^3/d$) discharge into the Clinton River and its tributaries. Localized effects to the lake are due to the inflow of the Clinton River and combined sewer overflows.

The U.S. portion of Lake St. Clair has been designated for cold water, fishing, public water supply, and total body recreation by the MDNR. The present quality of Lake St. Clair is difficult to assess because of a lack of continuous and complete data for stations in the lake. High quality upstream waters and a short water residence time lessen the impact of the Clinton River discharge into Lake St. Clair.

The Clinton River mainstream from Pontiac to the mouth and the Red Run River are designated water quality segments by the MDNR. A water quality segment, as defined by the Code of Federal Regulations (Title 40), is a section of water which does not meet and/or is not expected to meet water quality standards even after the enforcement of effluent limitations on discharges into the stream. Point sources which discharge into a water quality segment are subject to stricter discharge requirements than are effluent limitation segments. Along water quality segments, steps are also taken to alleviate the water quality problems imposed by non-point sources. Water quality segments require that more stringent criteria be met by point sources, and/or that non-point discharges be reduced, in order to meet the state water quality standards. In contrast, an effluent limitation segment is one which meets or will meet established water quality standards after application of effluent limitations to point source discharges. These effluent limitations are based on secondary treatment for municipal discharges, or on best available technology economically available for industrial discharges (PL 92-500).

Water quality data is presented by the facilities planning consultant (Giffels/Black and Veatch, 1977, Book VI) for seven stations along the Clinton River. Suspended solids range from 22 to 46 mg/l with the standard 30 mg/l exceeded at some stations. The recommended phosphorus standard of 0.10 mg/l is exceeded at all stations, with recorded concentrations varying from 0.21 to 1.8 mg/l. Fecal coliform counts have a wide variability ranging from 350 to 3200 MPN/100 ml. The standard count for the Clinton River is 1000 MPN/100 ml.

The uses designated by the MDNR for the Clinton River downstream of Pontiac and all of the Red Run are industrial water supply, partial body contact recreation, warm water fishery, agricultural water, and navigation.

The entire River Rouge Basin is considered an effluent limitation segment by the MDNR and is a major source of pollution to the Detroit River. The uses designated by MDNR for the watershed are industrial water supply, partial body contact recreation, warm water fishery, agricultural water, and navigation.

The Great Lakes Basin Commission (GLBC) reports that the lower 15 miles (24 km) of the River Rouge are severely degraded, and its dissolved oxygen content severely depleted. This is documented in a 1973 MDNR water quality survey, during which all of the sampling stations in the River Rouge from Plymouth Road (Mile Point 15.6) to the mouth had dissolved oxygen values less than 4.0 mg/l as a single value minimum. Lowest average and single dissolved oxygen volumes in the River Rouge were at Jefferson Avenue (Mile Point 1.1) with surface values of 1.0 mg/l and 0.2 mg/l, respectively (MDNR, 1974). Deteriorated conditions were attributed to nine industrial discharges and numerous combined sewer overflows from Detroit and the suburbs.

The facilities planning consultant's data indicate that neither total phosphorus, suspended solids, or fecal coliform counts are in compliance with state standards. Water quality standards on the Clinton River also apply to the River Rouge. Phosphorus concentrations at the six monitor stations presented range from 0.16 to 0.67 mg/l. Suspended solids concentrations vary between 32 and 71 mg/l. Fecal coliform estimates are extremely high, especially at Fenkell Avenue and West Jefferson Avenue, and range from 2100 to 27,000 MPN/100 ml.

The Michigan portion of the Detroit River has been designated by MDNR as suitable for a cold water fishery, public water supply, and total body contact recreation. The MDNR has established water quality standards for the Detroit River that are essentially the same as for the Great Lakes.

Water quality in the Detroit River has improved in recent years, as reported from separate studies done by the IJC in 1913, 1948, 1962, and 1975 and ENCOTEC in 1974 (Giffels/Black and Veatch, 1977, Book II). Levels of dissolved oxygen, dissolved solids, suspended solids, chloride, ammonia nitrogen, and nitrate nitrogen are currently in compliance with Michigan water quality standards. Dissolved iron in the Detroit River is also in compliance with existing standards (300 µg/l). The DWWTP, however, contributes 90 percent of all U.S. municipal total iron loadings or 85,334 lb/day (38,700 kg/day). High total iron levels are due to the addition of ferrous chloride in the treatment process for phosphate removal. The iron has not been settling out efficiently because of the lack of secondary settling capacity.

Fecal coliform levels, an indication of sewage contamination, exceed standards (200 MPN/100 ml) at the sampling station immediately below the mouth of the River Rouge. Monitored stations along the river reveal a range of 100 to 1700 MPN/100 ml.

Levels of phenol also exceed standards. The DWWTP discharges approximately 75 percent of the known phenol loading from U.S. municipal sources. Levels of all trace elements and pesticides presently meet either Michigan standards or Federal Water Quality Standards.

There are no current water quality standards for phosphorus concentrations in receiving waters but a maximum allowable limit of 20 µgP/l (0.02 mgP/l) was chosen by the joint venture for the Detroit River and the western basin of Lake Erie (Giffels/Black and Veatch, 1977, Book VI). The Detroit River is not in compliance with this recommended standard anywhere along its length. Concentrations more than triple below the outlet of the River Rouge, increasing from 0.04 to 0.14 mgP/l.

The IJC Detroit River Loading Budget for water year 1975 attributes the highest loads of total phosphorus to U.S. municipal sources. The DWWTP effluent contained an average of 27,800 lb/day (12,600 kg/day) of phosphorus or 87 percent of the known municipal load in 1975.

Trends in water quality were also reported by the IJC and ENCOTEC (Giffels/Black and Veatch, 1977, Book II). There is mutual agreement that levels of total phosphorus and chlorides have decreased over the years 1962 to 1974 while nitrate-nitrogen levels have increased. There was no agreement on trends in levels of ammonia-nitrogen, phenol, and total iron. ENCOTEC reported increases in dissolved solids and no trends in fecal coliform counts.

The dilution capabilities of the Detroit River and its relatively clean upstream waters reduce the impacts of substandard discharges within its 32 mile length (51.5 km).

The Detroit River delivers four-fifths of Lake Erie's annual influent; therefore, the small, shallow western basin receives the immediate and greatest impact. Water reaches the central basin of Lake Erie relatively quickly because of the short water residence time in the western basin (0.17 years).

The western basin is influenced by its populated, industrialized watershed and its morphology. Its two main tributaries contribute a heavy chemical load. The GLBC estimated in 1976 that the principal source of suspended material was the Maumee River (2,270,000 tons/yr. suspended solids) while the major source of dissolved material was the Detroit River (33,580,000 tons/yr. dissolved solids).

The Army Corps of Engineers estimated the annual total phosphorus load from the Detroit River for 1974-1975 at 10,633 tons (9,644 metric tons) and from the Maumee River at 2,462 tons (2,233 metric tons). The IJC 1976 total phosphorus loadings are similar: Detroit River, 10,220 metric tons/yr.; Maumee River, 1687 metric tons/yr. (IJC, Personal Communication, 1977).

The IJC concluded that phosphorus loads from the Detroit River have decreased by more than 60 percent since 1968, although 1975 measurements showed a slight increase over 1974.

Municipal discharges are the greatest point source of phosphorus to Lake Erie and the Detroit River loadings continue to make a significant contribution to the eutrophic conditions in the western and central basins.

Although the Detroit River is the largest source of chemical loading to the western basin, it also has the largest flow rate. This tends to provide higher quality water than that in the southern part of the basin. High levels of soluble reactive phosphorus (biologically active form) in the Toledo-Maumee area from agricultural runoff sources plus point sources make this area the leading contributor of phosphorus pollution to the western basin. Levels of chlorophyll a in the southern part of the basin including the Maumee Bay area averaged four times greater (12.1 μg/l) than chlorophyll a concentrations in the northwestern portion of the basin (3.65 μg/l) around the Detroit River in 1973 (Schelske and Roth, 1973). This information appears to substantiate the above statement but differing lake conditions and analytical methods in western basin studies result in variable data.

Composite data from 1968 to 1974 show high numbers of fecal coliform bacteria entering the western basin from major tributaries. Fecal coliform densities greater than 2000 MPN/100 ml were associated with the Raisin River (south of the study area) and Maumee River influents. Coliform counts around the mouth of the Detroit River ranged between 1000 and 2000 MPN/100 ml. The Michigan Water Quality Standard for fecal coliform in water designated for total body contact recreation is 200 MPN/100 ml.

The trace element of most concern in recent years is mercury, which concentrates in the aquatic food chain and is toxic to aquatic biota and humans. Thomas and Jaquet (referenced in Giffels/Black and Veatch, 1977, Book II) concluded that the Detroit River was the major source of mercury to the western basin of Lake Erie. The annual load (1976) is 7.9 tons (7.2 metric tons). Based on sediment analyses, it was further concluded that Lake St. Clair is serving as a mercury-enriched sediment reservoir whereby resuspended sediment is transported to Lake Erie through the Detroit River. Sediment analyses from 30 stations in Lake St. Clair, the Detroit River, and Lake Erie in 1970 averaged 16.95 mg/kg mercury dry weight (MDNR, 1972). Excessive mercury residues in sediments are known to dissipate slowly.

### 2.5.3 Groundwater Quantity and Quality

In the four county area immediate to Detroit (Washtenaw, Wayne, Macomb, and Oakland) the potential groundwater yield has been estimated at 320 mgd (1,211,200 $m^3/d$) (Giffels/Black and Veatch, 1977, Book II).

Both consolidated and unconsolidated sediments are sources of groundwater. Bedrock aquifers in the study area provide low yields of usually high mineralized water with great hardness, high iron content, and occasional traces of hydrogen sulfide or methane gas. They are formed of sedimentary rock several hundred feet thick and dip to the northwest at approximately 30 feet/mi. (6m/km).

The unconsolidated aquifers or the glacial drift areas range from a few feet to 330 feet as they overlie the bedrock to the west and northwest. Most of the groundwater resources in the four county area are taken from these strata. Of the moraine, till, and outwash deposits, the latter are the best source of water supply. Water quality is variable from this glacial drift material but generally better than that from bedrock.

Alluvial deposits are the only other source of groundwater in the area and these are chiefly along the Huron River and River Rouge and their main tributaries. They produce appreciable amounts of water when thick and permeable enough or when in proximity to perennial streams. The water quality of alluvial deposits is very similar to that of nearby stream quality under base flow conditions.

Except for the alluvium which is recharged by the stream flowing over it, the aquifers are all recharged by precipitation on their outcrop area or by percolation of precipitation through overlying permeable material. The most favorable recharge areas are to the north and west of the area.

In the River Rouge Basin both bedrock and glacial drift produce small to moderate yields ranging from less than 10 gpm (0.6 l/s) to over 500 gpm (32 l/s) depending on location. Bedrock water is highly mineralized and glacial drift water is generally very hard (greater than 180 mg/l as $CaCO_3$), though suitable for municipal and industrial supplies.

In the Clinton River Basin, yields from the lake bed deposits and moraine and till deposits range from around 10 gpm (0.6 l/s) in the east to 500 gpm (32 l/s) in the western part of the basin. Water in the glacial drift is very hard, ranging from 200 to 400 mg/l as $CaCO_3$, but of acceptable quality. Bedrock generally provides poor yields of about 10 gpm (0.6 l/s), except for a very small area in the northwest corner. This aquifer provides water appropriate for domestic consumption in the northern part of the basin; however, in the southern portion of the basin the water is progressively too mineralized and high in chloride.

The most favorable aquifer recharge areas are to the north and west, but their significance to the study area is relatively minor. The Great Lakes are the primary source of water for all of southeastern Michigan. Water use data for 1970 indicates that groundwater satisfied only 6 percent of the total average municipal demand, with projected demands for 2020 even lower. With the large volumes of water available and the extensive distribution system, future dependency on groundwater supplies are not anticipated.

### 2.5.4 Water Uses

The study area relies more on surface water than groundwater for its water supplies. Groundwater resources provided about 2 percent of the total average municipal demand in 1970 (Giffels/Black and Veatch, 1977, Book II).

The DWSD provides water supply service from four water treatment plants to 97 communities located in a service area of approximately 860 square miles (2,227.4 km$^2$). Daily water consumption ranged from 121-226 gcd (0.46-0.86 m$^3$/cd) from 1971 to 1976, with no apparent trends of increasing water use.

## 2.6 Biology

### 2.6.1 Aquatic Communities

High quality water and associated aquatic communities exist at headwater streams and the Lake Huron outflow into the St. Clair River. Fish species, such as lake sturgeon and salmonids, and copepods are representative of the oligotrophic water received by the St. Clair River (Giffels/Black and Veatch, 1977, Book III).

The aquatic community in Lake St. Clair, particularly the western shoreline, reflects nutrient enrichment from agricultural runoff, municipal wastewater treatment plant discharges, and combined sewer overflows. High algal productivities are dominated by cyanophytes (blue-green algae). Benthic invertebrates such as sphaerid clams and caddisflies, which are adapted to cold, well oxygenated water, are numerous.

Most waters in the Clinton River and River Rouge watersheds are second quality warm water streams (USDA, 1975). These streams are capable of supporting good populations of warmwater game fish except for such factors as lack of natural reproduction, overabundance of competing species, and the presence of heavy silt or other pollution. Water providing a top quality warmwater fishery habitat are much less numerous and generally located in the upper reaches of the Clinton River tributaries.

A portion of the Clinton River north of Pontiac is a second quality coldwater stream capable of supporting a trout fishery if certain fish management and pollution problems are corrected. This stream segment has the same limitations as the second quality warm water streams.

Gradual degradation of downstream water in the Clinton River is paralleled by changes in species composition and species abundance, with an increasing dominance of pollution tolerant organisms (Grant, 1974). Above Pontiac, a diverse warmwater fish population exists, including chubs, dace, shiners, darters, and introduced trout. Sunfish, perch, and pike are found near Pontiac. Below Pontiac to Paint Creek, mudminnows, shiners, and sunfishes are dominant. Near Mt. Clemens only suckers and carp are caught. The fish populations in the lower Clinton River are typical of a warm water polluted river habitat. The species composition of periphyton and zoobenthos also changes below Pontiac; intolerant species have been largely eliminated suggesting that the bottom habitat has deteriorated (Grant, 1974).

Although the headwaters in the River Rouge watershed are inhabited by species which prefer good water quality, all of the main branches of the River Rouge, including Evans Ditch, are increasingly polluted as one moves downstream. Diatoms (*Nitschia*, *Navicula*, and *Melosira*) and macrophytes (*Potamogeton* spp., *Ceratophyllum*, and *Cladophora*) which are indicative of organic enrichment in water and sediments, are common flora along the major tributaries. Fish and zoobenthos populations also undergo transition, as one moves downstream, to species which are more tolerant of a stressful habitat. The river bottom habitat between the confluence of the Lower Rouge and Detroit River is characterized by sludge bed development. Macrophytes are generally absent from this segment and the only dominant phytoplankton in 1973 was *Melosira*. Sessile colonial ciliates, similar to those in sewage trickling filters, plus the absence of chironomids, which are usually tolerant of near anoxic conditions, are absent. Only carp and fathead minnows are found below the confluence of the Upper Rouge (Jackson, 1975).

The lower Detroit River below the confluence with the River Rouge is also a severely degraded habitat, particularly the river substrate.

Little change in diversity or abundance of phytoplankton has been noted between the Detroit River headwaters and mouth (U.S.EPA, 1974A). Macrophyte biomass and diversity decrease with increasing turbidity in water.

Downstream of the confluence of the River Rouge, an extreme change in zoobenthos species composition occurs. Dominant species are those that can tolerate an oxygen poor habitat such as phantom midges (Chaoborus), midges (Chironomus spp.) and sludgeworms (Limnodrilus spp.).

A diverse fish population existed in 1976 in the Detroit River, including pollution tolerant and intolerant species. Due to the rapid flushing of the river, the segregation of the River Rouge effluent to the west shoreline, and the mobility of fish, the river's pollutants did not greatly suppress intolerant species.

The Detroit River influences the western basin of Lake Erie north of Stony Point. Nutrient-rich water and sediment in the western basin of Lake Erie have resulted in higher levels of algal productivity. Changes in primary production are documented by an increased abundance of phytoplankton cells in the spring and fall and shifts in the dominant algal species to blue-green algae (Microcystis) and diatoms (Schelske and Roth, 1973). Primary productivity from macrophytes has declined due to turbidity and high water.

The MDNR concluded in 1973 that the Detroit River, although having the best water quality input to western Lake Erie, contributed sediments which produced the most pollution-stressed zoobenthos. Benthic invertebrates found in western Lake Erie are similar to those in the lower Detroit River which are tolerant of silty, organic sediments.

Fish harvest and diversity are greater in Lake Erie than any other of the Great Lakes. The original fish habitats have been altered (1) physically by dredging and dumping, (2) by the addition of toxic pollutants, and (3) by accelerating the natural processes of eutrophication through nutrient additions. In 1973 the National Commission on Environmental Quality listed point source pollution from southeast Michigan as the most limiting factor to fish populations in Lake Erie.

Although fish production has increased, high quality fish species, such as cisco, blue pike, and lake sturgeon have been replaced by species of less value such as freshwater drum and carp. Medium value species (white bass, yellow perch) are sufficiently abundant to have commerical importance.

The Detroit River is the only tributary to Lake Erie which significantly contributes to its existing commercial fishery

(Applegate and VanMeter, 1970). The river serves as a channel for continual interchange of fish stocks between Lake St. Clair and the western basin. Maintenance of the Detroit River water quality is important to the future commercial fishery resources in Lake Erie.

It is impossible to assess the relative effect of eutrophication, pollutants, introduced species, and over-exploitation on Lake Erie's changing fishery resources. But there is no doubt that massive destruction of the insect food supply over hundreds of square miles of lake bottom, silt deposition on the spawning grounds, and dramatic changes in the phytoplankton have all directly influenced at least some of the fish populations (Hartman, 1970).

Seventy-one aquatic species are listed as rare, threatened, or endangered in the study area or its receiving waters (Appendix 11.2). They have declined or disappeared mostly due to environmental changes induced by man. The American Lotus is the only aquatic floral species listed as endangered in Michigan. The remaining sensitive species are aquatic animals.

### 2.6.2 Upland and Forest Resources

Detroit is located near the interface of two major forest regions: the Beech-Maple and the Oak-Hickory (Braun, 1950). This has resulted in a flora containing species characteristic of both. Woodlands have been classified as those areas which are more than 80 percent covered by trees. Within the City of Detroit, less than 2 percent of the land area is woodland (Giffels/Black and Veatch, 1977, Book III).

There are a variety of terrestrial habitats present, each with a distinctive flora (Giffels/Black and Veatch, 1977, Book III). Deciduous forest floodplains are found along many streams. Lake shores, marshes, swamps and bogs, representing gradations between aquatic and terrestrial conditions, are present. Meadows, successional stages that normally follow wetlands, are found in both wet and dry forms. The wet meadow is the stage after wetlands, while the dry meadow is prior to the upland forest development. Several upland forest types are located in the three county area, and they represent phases of the two major forest regions.

With the diverse habitats, and a location that is at the boundary of the range of many northern and southern species, a wide variety of faunal species may be present. Mammals present may include species such as the Canadian lynx, characteristic of a more northern climate, and the southern flying squirrel, which reaches its northern limits in Michigan. Major bird migratory routes are located around Detroit, resulting in visitation by species characteristic of more northern areas. Michigan's reptiles and amphibians, like that of most northern states, are limited in variety.

Endangered faunal species may be found in the three county area but have not been specifically cited. Species including mammals, birds, reptiles, and amphibians listed by federal or state agencies as being endangered, threatened or rare are found in Appendix 11.2. No terrestrial plant species on the endangered lists have been identified in the Detroit area.

### 2.6.3 Wetlands

Wetlands within the study area include bogs, marshes, shrub swamps, and wooded swamps (Giffels/Black and Veatch, 1977, Book III). Oakland County has the greatest acreage of wetlands (22,900 acres), most of which are scattered throughout the undeveloped portions of the county. Wetlands in Macomb County (638 acres) are confined to two major locations: the Huron Point Marshes and the Salt River Marsh. Wayne County's wetlands (13,048 acres) are limited to the borders of the Detroit River, Celeron Island, and Humbug Marsh. Acreage estimates are from a 1976 survey by MDNR biologists. The acreage figures do not present only areas of wetlands but present those areas judged to be habitat for waterfowl. The definition of habitat includes parts of lakes, wetlands, and uplands, and provides the best estimate of wetlands available to the study team.

MDNR considers all the sensitive habitat acreage in Wayne and Macomb Counties (13,686 acres total) plus 565 acres in Oakland County (Clinton River-Avon Township) to be threatened in the next 1-5 years (Giffels/Black and Veatch, 1977, Book III). Loss of this kind of wildlife habitat is generally attributed to encroachment by residential and/or recreational development.

### 2.7 Air Quality

The study area is included within the Metropolitan Detroit-Port Huron Intrastate Air Quality Control Region (AQCR). Counties in the AQCR include Wayne, Macomb, Oakland, and St. Clair. The AQCR has also been identified as an Air Quality Maintenance Area (AQMA) for particulates. An AQMA designation indicates that the potential exists for violating National Ambient Air Quality Standards within the next 10 years. For development of the State Implementation Plan, the AQCR is classified as priority I for particulates and sulfur oxides and priority III for nitrous oxides, carbon monoxide, and oxidants (140 CFR 52). The priority classification system is used in order to most efficiently allocate air quality planning resources to problems of the greatest magnitude. Priority I areas are those with the worst air quality problems.

Existing air quality in the study area has been well documented (Giffels/Black and Veatch, 1977, Book II). Air pollution in the area comes primarily from heavy industry along both shores of the waterway. The greatest emissions occur on the west bank of the Detroit River from just southwest of the downtown area to opposite Grosse Isle. Although the emissions are large, favorable meteorological conditions serve to disperse and dilute pollutants to a large degree. However, if the area is to attain ambient air quality standards, there must be a significant reduction in emissions.

Air pollutants are generally monitored near ground-level by a variety of accepted techniques generally classified as either continuous or intermittent, but statistically significant, sampling.

The national ambient air quality standards (Giffels/Black and Veatch, 1977, Book II) must not be exceeded more than once a year per site. Macomb and Wayne Counties have a total of more than thirty-two continuous air sampling sites. Oakland County has between five and fifteen monitored sites.

### 2.7.1 Suspended Particulates

Macomb and Oakland Counties are consistently in compliance with the primary standard for particulates. Wayne County continues to violate both the 24-hour and annual primary standards at a number of sites.

### 2.7.2 Sulfur Dioxide

State and industrial monitoring sites in Macomb and Oakland Counties are regularly in compliance with both primary and secondary standards.

Pre-1974 data for Wayne County show occasional violations of sulfur dioxide standards. Since 1974, neither primary nor secondary standards have been violated.

### 2.7.3 Nitrogen Dioxide

In Macomb and Wayne County three bubbler samplers (respectively) continue to show annual average $NO_2$ levels well below the standard.

Although $NO_2$ standards have never been violated in Oakland County, one site consistently shows high levels. This site is located near the Southfield and Lodge Expressways where there is extensive vehicular traffic.

### 2.7.4 Carbon Monoxide

Limited monitoring in Macomb County shows no violations of either the one or 8-hour standard.

In Oakland County, two violations of standards were recorded in 1975 at the Southfield and Lodge Expressways site.

Three of the four established sites in Wayne County violated the 8-hour standard in 1974 and 1975. The number of violations shown at these sites was approximately the same both years. In July, 1975, a new carbon monoxide monitoring site was established in the immediate downtown area to monitor the levels of carbon monoxide which may be attributed to the so-called "canyon effect." A typical "canyon", or valley, is formed by the tall buildings surrounding the heavily travelled surface streets thereby impeding the dispersion of carbon monoxide. This site recorded 17 violations of the 8-hour standard with the maximum being about 50 percent above the standard (MDNR, 1975).

## 2.8 Aesthetics

### 2.8.1 Visual

Visual aesthetics are presented in two contexts, those of the planning area, and those directly related to the wastewater management system. Visual aesthetics are a result of local and regional planning, zoning and a commitment to preservation of open space. In the City of Detroit and the surrounding three county area, large segments of land have been reserved for open space.

In relation to the waste management system, visual considerations become important and can cause problems, based on the location and appearance of treatment and collection facilities and their proximity to residential areas.

The DWWTP is located at the confluence of the Detroit River and River Rouge in an area that is heavily industrialized. However, the treatment plant borders a local church on three sides. The proximity of the church to the treatment plant has generated complaints by the parishoners.

Seventeen pump stations are operated by DWSD. These pump stations are mostly unmanned and visual appearance is directly related to the design, operation and maintenance of these facilities.

### 2.8.2 Noise

External noise from the wastewater management system is generally low except at specific points within the structures. Specific areas of nuisance noise are the incinerator complexes, the oxygen plant, and the blower complex. Fenceline noise surveys to determine the noise levels from facilities as influencing the surrounding area have not been undertaken (Giffels/Black and Veatch, 1977, Book IX). No community complaints have been attributed to the DWWTP, probably due to adjacent heavy industry and heavy truck traffic.

### 2.8.3 Odors

Odors relating to the operation of the collection system, treatment plant and incineration facilities have not been analyzed by the facilities planning consultant. However, the only known source of significant odors is the incinerators at the treatment plant site. Inefficiency within the incinerators results in less than adequate combustion. This process causes obnoxious odors to be emitted during operation. Complaints by local citizens concerning odors have been received; however, the actual source of the complaint odors has not been determined (Giffels/Black and Veatch, 1977, Book II).

## 2.9 Institutional and Governmental Jurisdictions

### 2.9.1 Facilities Plan Study Area

The facilities plan study area includes the City of Detroit.

### 2.9.2 Overview Study Area

Within the overview study area, there are 90 local jurisdictions (Figure 2.9-A) including Wayne, Macomb and Oakland Counties. Ten of these communities own and operate their own collection systems (Table 2.9-A).

TABLE 2.9-A

INDIVIDUAL CITIES SERVED BY DWSD

| | |
|---|---|
| Allen Park (part) | Grosse Pointe Farms |
| Centerline | Grosse Pointe Park |
| Dearborn | Hamtramck |
| Farmington (part) | Highland Park |
| Grosse Pointe | Melvindale |

Table 2.9-B presents the local jurisdictions as they are organized into sanitary districts. The small areas in Lapeer and St. Clair Counties including Almont are not included. The sanitary district includes areas which are presently served, areas for future service, and areas which have their own sewage treatment and collection facilities.

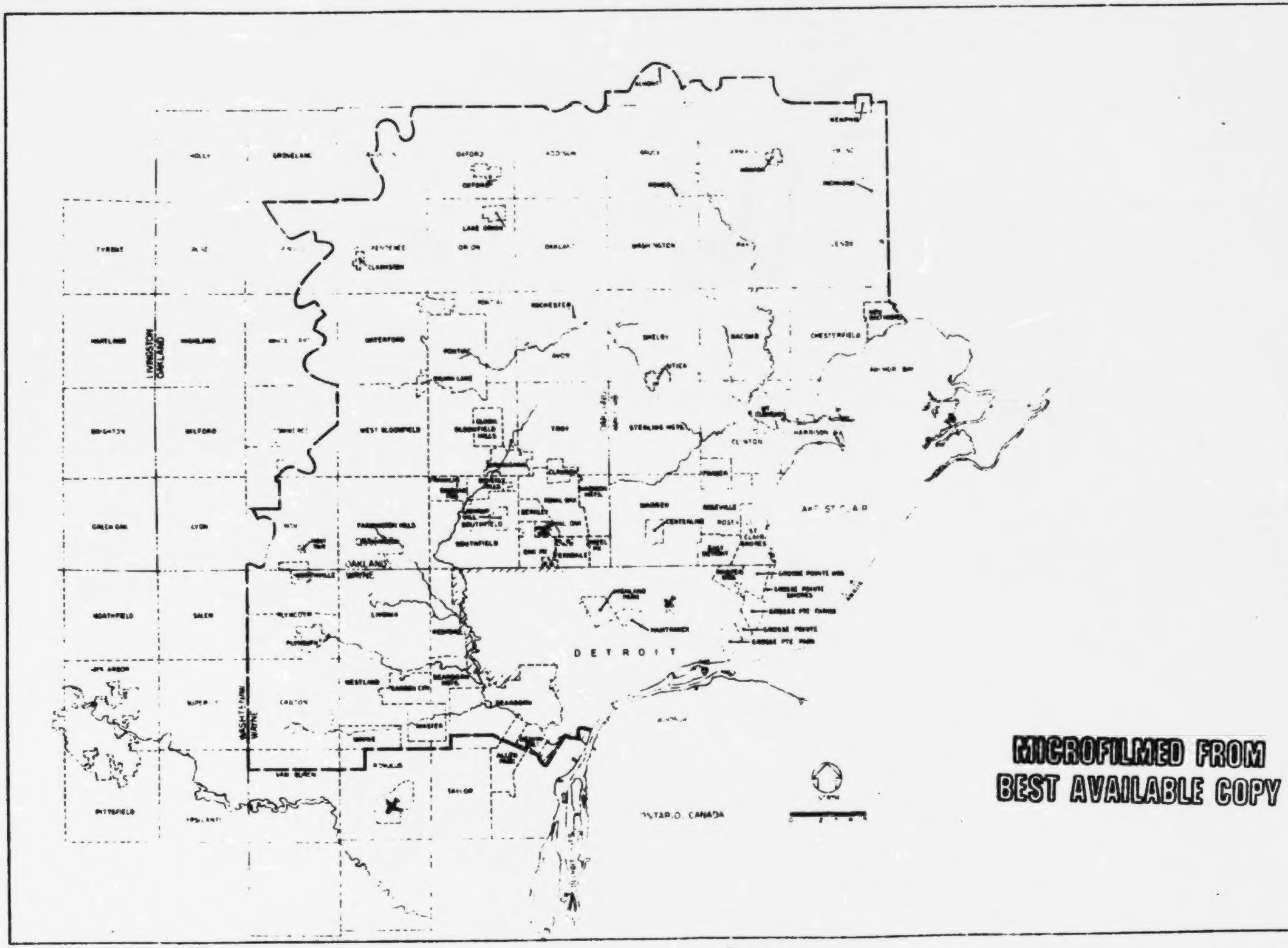
HOLLY
GROVELAND
OXFORD
ADDISON
BRUCE
ARMADA
LAKE ORION
TYRONE
INDEPENDENCE
CLARKSTON
ORION
OAKLAND
WASHINGTON
LENOX
ROCHESTER
HARTLAND
LIVINGSTON
OAKLAND
HIGHLAND
WATERFORD
PONTIAC
SHELBY
MACOMB
CHESTERFIELD
UTICA
ANCHOR BAY
BRIGHTON
MILFORD
WEST BLOOMFIELD
TROY
STERLING HGTS
CLINTON
HARRISON
GREEN OAK
LYON
FARMINGTON HILLS
SOUTHFIELD
WARREN
ROSEVILLE
CENTERLINE
LAKE ST CLAIR
OAKLAND
WAYNE
NORTHFIELD
SALEM
PLYMOUTH
LIVONIA
REDFORD
GROSSE POINTE
DETROIT
ANN ARBOR
SUPERIOR
CANTON
WESTLAND
GARDEN CITY
DEARBORN
WASHTENAW
WAYNE
VAN BUREN
ROMULUS
TAYLOR
PITTSFIELD
YPSILANTI
ONTARIO, CANADA

Figure 2.9-A
Overview Planning Area

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## Table 2.9-B

## Jurisdictions Within Sanitary Districts

### Rouge Valley Sewage Disposal District - Wayne County

Garden City
Inkster
Livonia
Northville
Northville Township
Plymouth
Plymouth Township
Redford Township
Wayne
Westland
Canton Township (part)
Dearborn Heights (part)
Van Buren Township (part)
Romulus (part)
Novi
Novi Township

### Northeast Wayne County Sanitary District

Harper Woods
Grosse Pointe Woods
Grosse Pointe Shores

### Southeast Oakland County Sanitary District

Berkley
Clawson
Ferndale
Hazel Park
Huntington Woods
Madison Heights
Oak Park
Pleasant Ridge
Royal Oak
Royal Oak Township
Beverly Hills Village (part)
Birmingham (part)
Southfield (part)
Troy (part)

### Clinton-Oakland Sanitary District

Avon Township
Independence Township
Oakland Township
Orion Township
Oxford Township
Pontiac Township (part)
Waterford Township
Village of Lake Orion
Village of Clarkston
Village of Oxford
West Bloomfield
Springfield Township
Sylvan Lake
White Lake Township
Pontiac
Rochester
West Bloomfield
Addison Township
Brandin Township
Village of Lake Angelius
Village of Leonard
Village of Orchard Lake

### Evergreen-Farmington Sanitary District

Beverly Hills Village (part)
Bingham Farms
Birmingham (part)
Bloomfield Hills
Bloomfield Township
Farmington City (part)
Farmington Hills
Keego Harbor
Lathrup Village
Pontiac Township (part)
Southfield (part)
Troy (part)
Franklin Village
West Bloomfield (part)

## Table 2.9-B
(continued)

Macomb Sanitary District

Chesterfield Township
Clinton Township
Fraser
Harrison Township
Macomb Township
Shelby Township
Sterling Heights
Utica
Mt. Clemens
Romeo
Bruce Township
Washington Township (part)
Armada Village
Armada Township
Lenox Township
Memphis
New Baltimore
New Haven
Ray Township
Richmond
Richmond Township
Warren

## 2.10 Population and Demographics

### 2.10.1 Central City

The City of Detroit's population has increased from approximately 1400 people in 1820 to an estimated 1975 population of 1,334,000. The greatest growth rate took place from 1910 through 1930. During this period over 1,100,000 people came to reside within the City of Detroit. Total population for the city peaked at approximately 1,850,000 people around 1950. Since that time, population declined at a rate of approximately 10 percent per decade until 1970. Between 1970 and 1975 the estimated rate of decline doubled to approximately 20 percent per decade (Giffels/Black and Veatch, 1977, Book V).

The cause of the decline in population can be attributed to many factors. The post-war period from 1946 to 1960 created a tremendous demand for both housing for newly formed families and employment. Increasing employment opportunities coupled with expanding transportation facilities and low development costs in the outlying areas created a shift in residential location preference away from the central city. This shift in development patterns from the centralized concept to a sprawl concept was encouraged by low cost energy, a strong economy, and increasing real income. The present land development patterns in the metropolitan region of Detroit are the result of these factors acting together over the past twenty-five years.

### 2.10.2 Regional

An overview of the urbanization pattern from 1940-1970 demonstrates the shift in locational preference that is evident from population growth statistics. Housing construction prior to 1940 concentrated in the cities of Detroit, Plymouth, and Pontiac. Each succeeding decade showed a change in concentration further away from the previous, a trend that is very typical of large metropolitan areas throughout the country. Data on growth trends of population from 1940 through 1970 (Table 2.10-A) show a continued strong growth rate in Macomb and Oakland County through the period. The Wayne County totals, however, show the influence of the City of Detroit. County population growth was moderate from 1940 through 1960 and remained fairly steady from 1960 to 1970. Additional data (SEMCOG, 1976A) show an estimated decline (1970-1975) of 150,000 people in Wayne County. While the growth of Oakland and Macomb Counties has moderated, the three counties had a total reduction of 41,143 people during the 1970-1975 period. Estimates of the seven county regional population (SEMCOG, 1976A) reveal the region to be decreasing as a percentage of total state population from an estimated 53.4 percent in 1970 to approximately 52 percent in 1975.

## TABLE 2.10-A

## HISTORICAL POPULATION FIGURES FOR THE STUDY AREA

| Jurisdiction | 1940 | 1950 | 1960 | 1970 |
|---|---|---|---|---|
| Detroit | 1,623,452 | 1,849,568 | 1,670,144 | 1,514,063 |
| Wayne County (excluding Detroit) | 392,171 | 585,667 | 996,153 | 1,156,305 |
| Macomb County | 107,638 | 184,961 | 405,804 | 626,069 |
| Oakland County | 254,068 | 396,001 | 690,259 | 907,123 |

Growth patterns (1970-1975) varied widely from an 11.9% loss in Detroit to a 198.4 % increase in Canton township. Within Wayne County, 23 of 43 minor civil divisions lost population during this period (SEMCOG, 1976A). Similarly, 8 of 27 communities in Macomb County and 19 of 59 communities in Oakland County also recorded reductions in total population. The largest influx of new residents occurred in Canton Township (+21,874) and Taylor (+16,028) within Wayne County, in Clinton Township (+11,635) and Sterling Heights (+23,935) within Macomb County; and in Troy (+17,981) within Oakland County.

## 2.11 Land Use and Development Trends

### 2.11.1 Existing Land Use

The present urbanization pattern demonstrates the suburban spread of the City of Detroit and a concentration of development in the corridors linking the regional centers of Ann Arbor, Detroit, Mt. Clemens, and Pontiac (Giffels/Black and Veatch, 1977, Book IV).

The distribution of various activities is demonstrative of the relationships among sectors of the region. Regional retail centers are concentrated around the periphery and in the Central Business District (CBD) of the City of Detroit. The Central Business Districts (CBD's) of Detroit, Mt. Clemens, and Pontiac have an estimated 7.7 million sq. ft. of retail floor space, while the peripheral areas of the cities have an estimated 12.7 million sq. ft. (SEMCOG, 1976B) (Figures 2.11 A, B, C, and D).

Institutional facilities considered include hospitals, educational facilities and correctional institutions. The attraction of the City of Detroit for the location of these facilities is evident. Of an estimated 14,000 hospital bed capacity in Wayne County, the City of Detroit has approximately 9000. The combined total bed capacity in Oakland and Macomb Counties is approximately 4000. Regional and statewide educational facilities are located almost entirely within Wayne County (including the City of Detroit). Prison facilities, however, are not concentrated in any particular area.

Regional office building concentrations are almost exclusively limited to downtown Detroit and the Detroit-Pontiac corridor. The City of Detroit has an estimated 16.6 million sq. ft., Oakland County has approximately 9.4 million sq. ft. and the remainder of Wayne County, combined with Macomb County totals approximately 0.8 million sq. ft. of office space.

Manufacturing concentrations are within the City of Detroit, along the Detroit River, and in the Detroit-Plymouth, Detroit-

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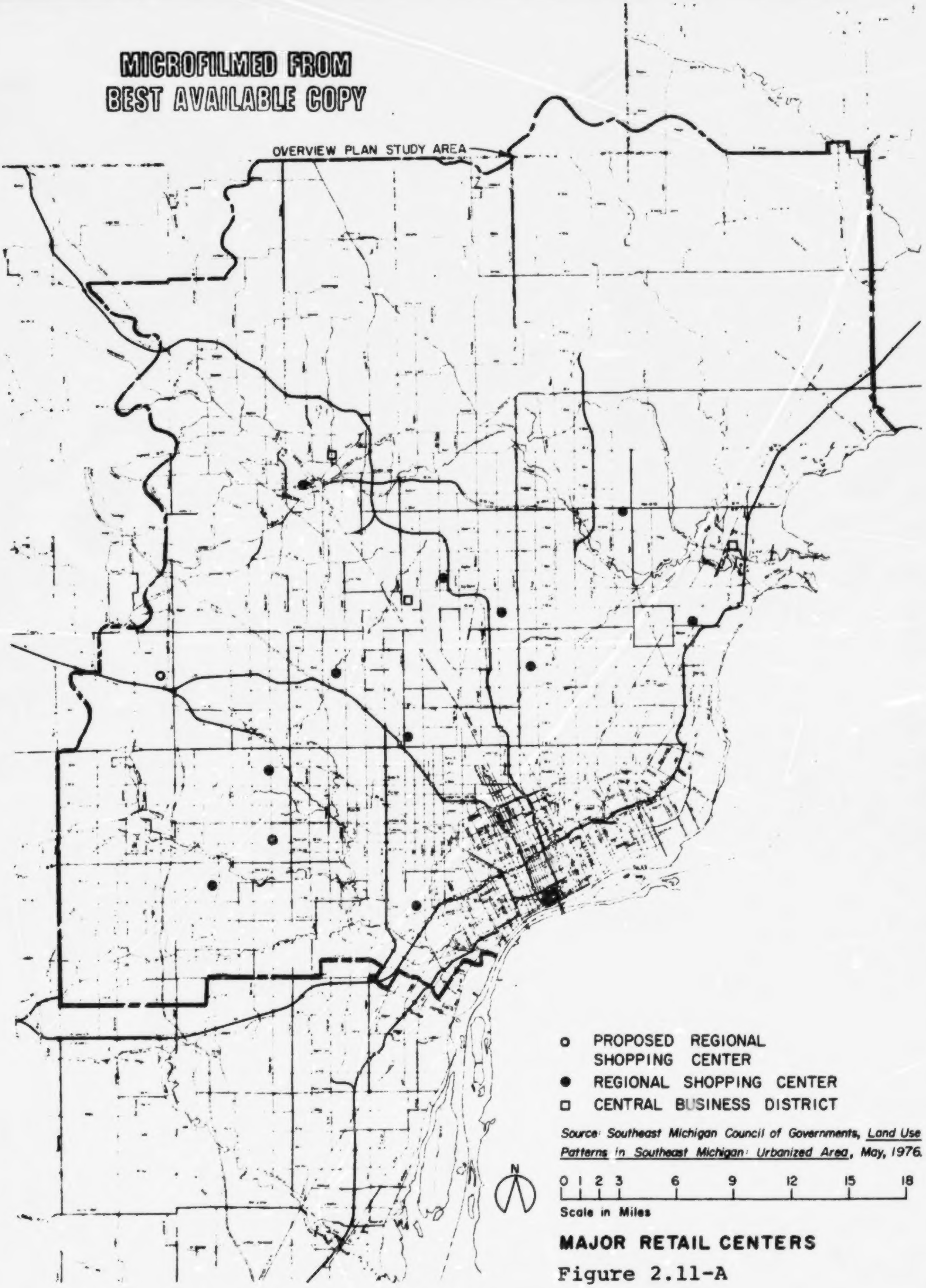
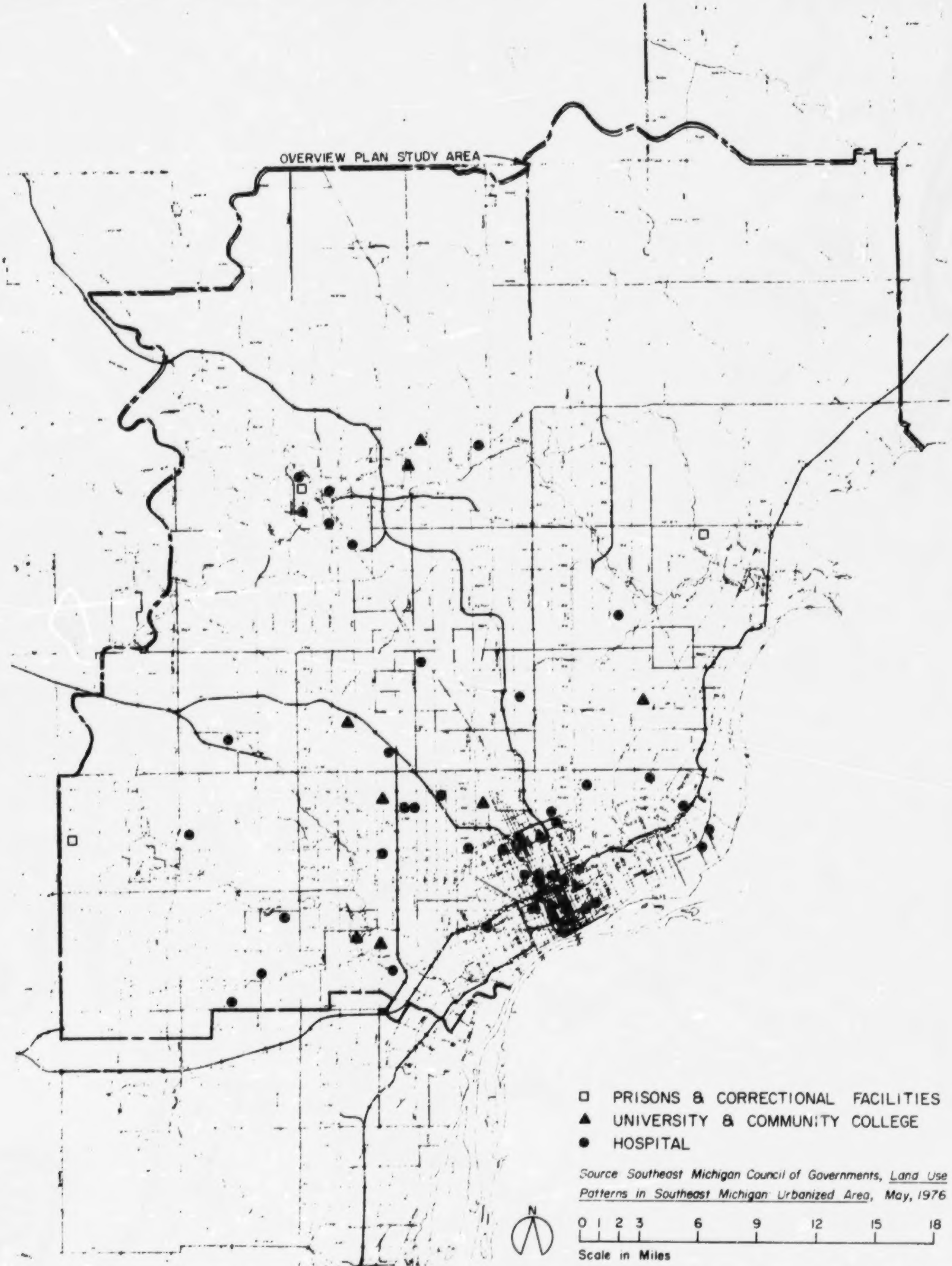

OVERVIEW PLAN STUDY AREA
○ PROPOSED REGIONAL SHOPPING CENTER
● REGIONAL SHOPPING CENTER
☐ CENTRAL BUSINESS DISTRICT
N
0 1 2 3 6 9 12 15 18
Scale in Miles

*Source: Southeast Michigan Council of Governments, Land Use Patterns in Southeast Michigan: Urbanized Area, May, 1976.*

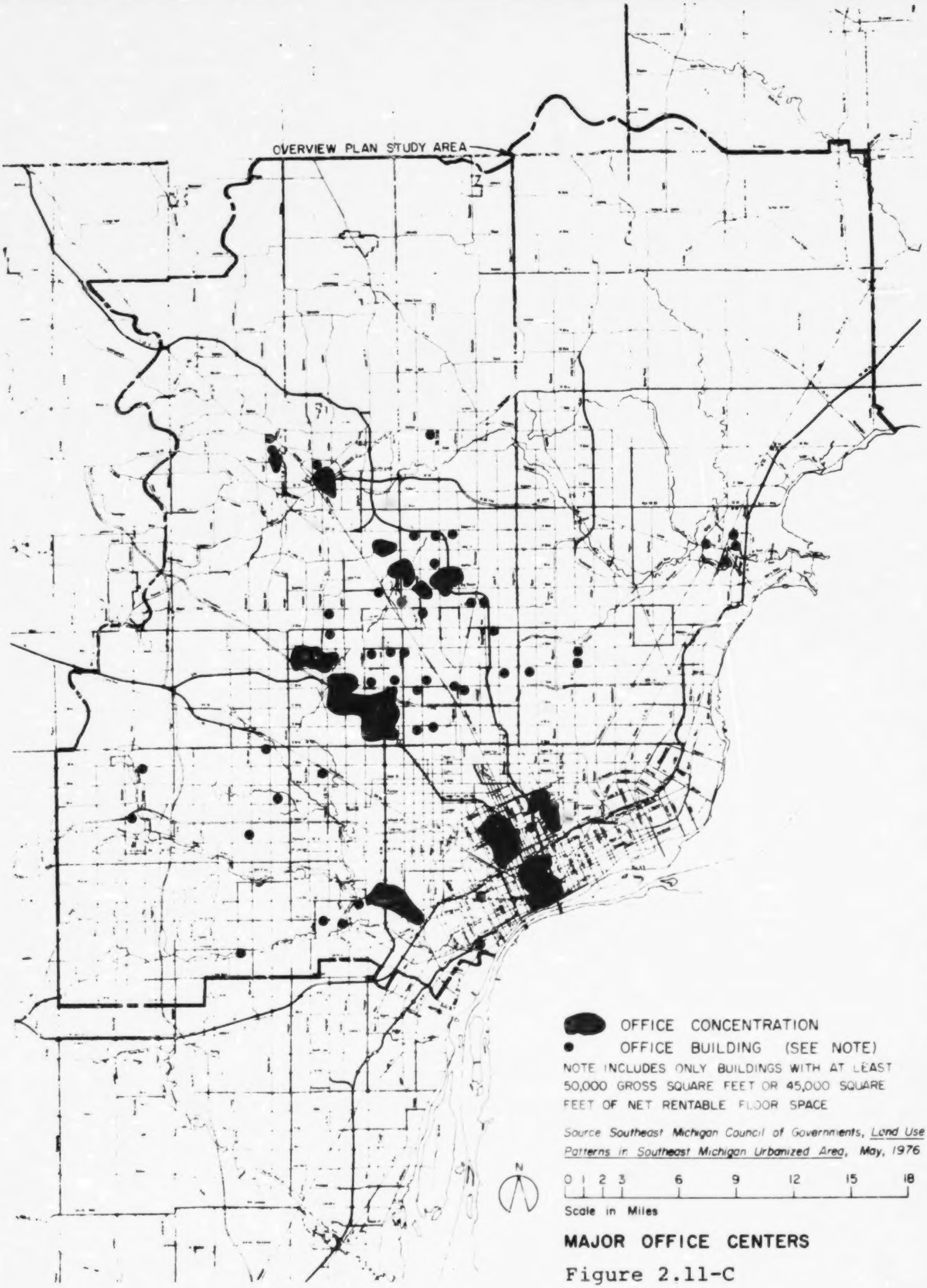
**MAJOR RETAIL CENTERS**

Figure 2.11-A


OVERVIEW PLAN STUDY AREA
□ PRISONS & CORRECTIONAL FACILITIES
▲ UNIVERSITY & COMMUNITY COLLEGE
● HOSPITAL
N
0 1 2 3 6 9 12 15 18
Scale in Miles

*Source Southeast Michigan Council of Governments, Land Use Patterns in Southeast Michigan Urbanized Area, May, 1976*

**MAJOR INSTITUTIONAL CENTERS**
Figure 2.11-B


OVERVIEW PLAN STUDY AREA
N
0 1 2 3 6 9 12 15 18
Scale in Miles

● OFFICE CONCENTRATION

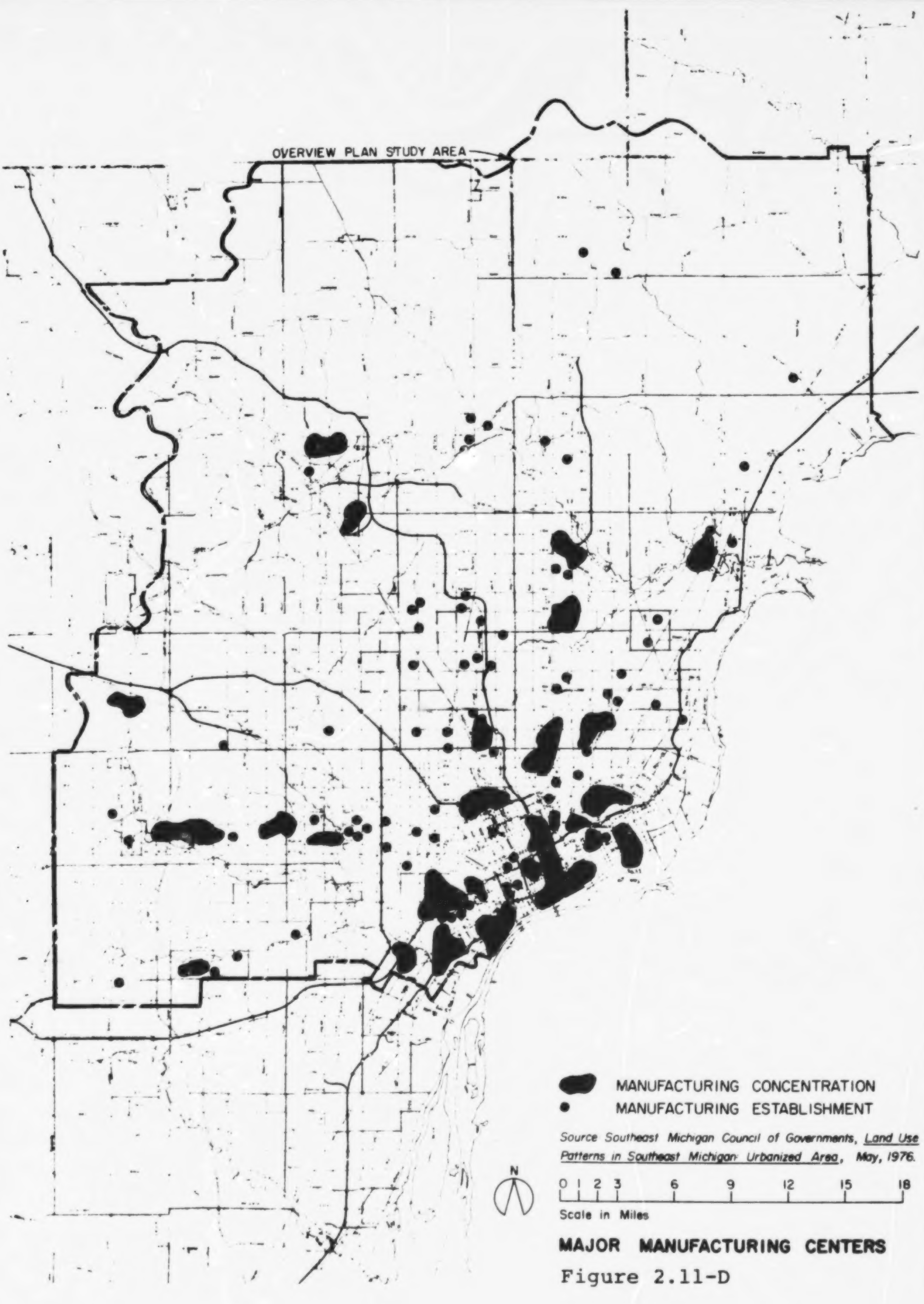
• OFFICE BUILDING (SEE NOTE)

NOTE INCLUDES ONLY BUILDINGS WITH AT LEAST 50,000 GROSS SQUARE FEET OR 45,000 SQUARE FEET OF NET RENTABLE FLOOR SPACE

*Source Southeast Michigan Council of Governments, Land Use Patterns in Southeast Michigan Urbanized Area, May, 1976*

**MAJOR OFFICE CENTERS**

Figure 2.11-C


OVERVIEW PLAN STUDY AREA
MANUFACTURING CONCENTRATION
MANUFACTURING ESTABLISHMENT
N
0 1 2 3 6 9 12 15 18
Scale in Miles

*Source Southeast Michigan Council of Governments, Land Use Patterns in Southeast Michigan Urbanized Area, May, 1976.*

**MAJOR MANUFACTURING CENTERS**

Figure 2.11-D

Pontiac, and Detroit-Utica corridors. Many manufacturing centers within the above mentioned corridors are also located near the River Rouge and Clinton River.

Approximately 27% of the land in the three county area is in residential use (Figure 2.11-E), 14% agricultural, 41% vacant, and 18% other uses (Table 2.11-A) (Giffels/Black and Veatch, 1977, Book IV). Special uses such as extractive uses and specialty crop agricultural uses are limited in the region. Sand and gravel operations are the major extractive uses. Other extractive uses in Oakland County include peat removal, and in Wayne County, cement, salt, lime, sulfur, clay, limestone, and sandstone. Current estimates of specialty crop acreage (soybeans, dry edible beans, sugar beets, potatoes, fruit, and commercial vegetables) shows approximately 19,800 acres in the River Rouge Basin and 19,400 acres in the Clinton River Basin.

Prime agricultural lands are defined by SEMCOG as areas which are actively being conserved or protected by local action to be kept in agricultural use (Giffels/Black and Veatch, 1977, Books II and IV). Within the study area there are nearly 100,000 acres of this type of land (Figure 2.11-F). In northeast Macomb County agricultural land is found in parts of Bruce, Washington, Ray, Lenox, and Chesterfield Townships, and most of Armada and Richmond Townships. A very small portion of agricultural land is located in northwest Oakland County in parts of Holly, Rose, Brandon, and Highland Townships. Nearly all of Center Township in Wayne County is agricultural.

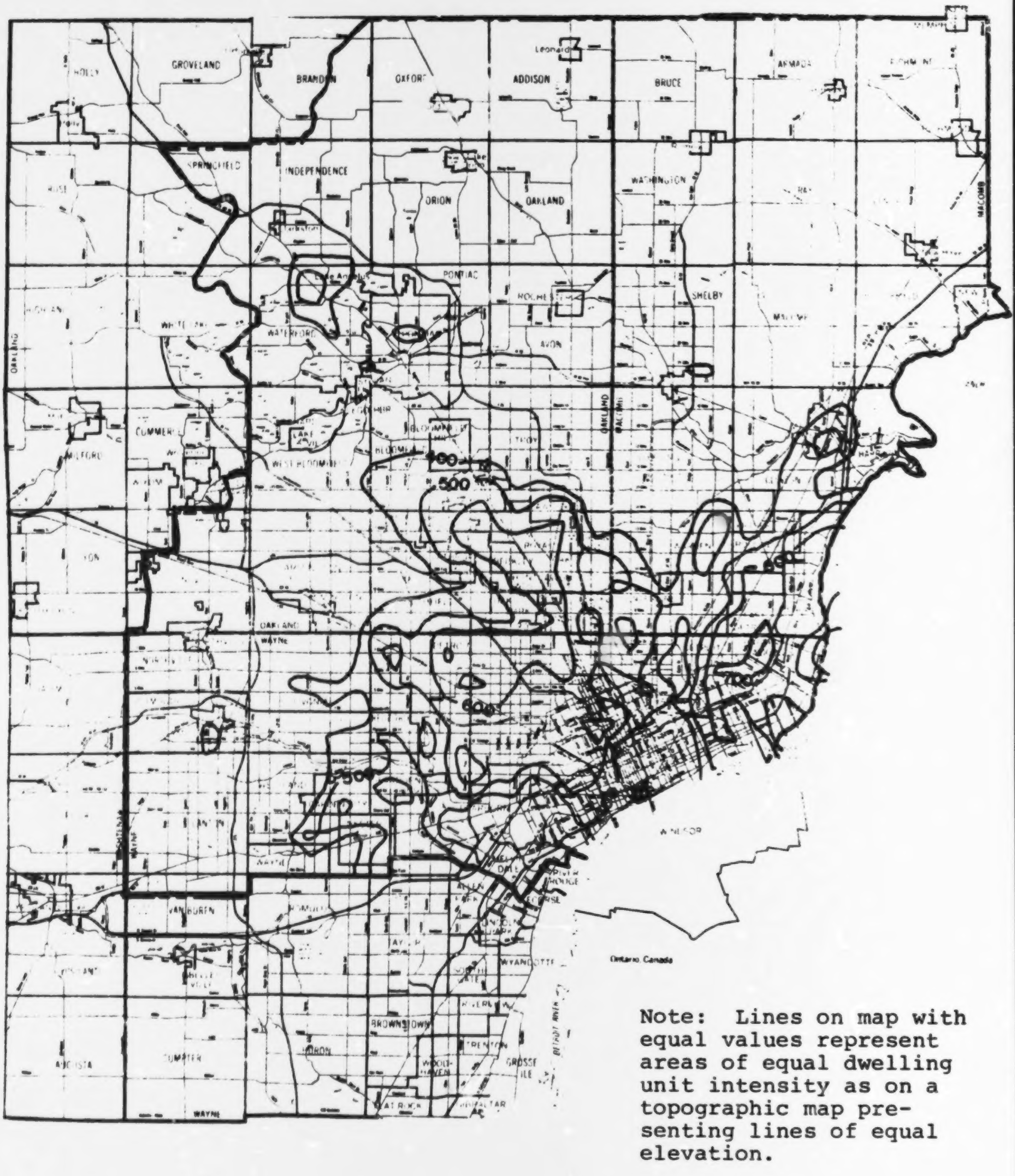
### 2.11.2 Development Trends

Development of the Detroit area was initially fostered by its location along the Great Lakes transportation routes. Development originally included establishments taking advantage of the bulk transport abilities of the Great Lakes system. Farming and lumbering dominated early activity followed by horse-drawn carriage manufacturing establishments (USDA, 1975).

Urbanization in Oakland and Macomb Counties paralleled most other areas in the eastern United States during the ninteenth century. Mainly devoted to agriculture, the area contained a number of small villages mostly along the water-courses. As development continued, urbanization was concentrated in the cities of Detroit, Pontiac, and Mt. Clemens. The strength of the regional economy, coupled with the sophistication of automobile transportation, allowed for the rapid spread of urbanization within the region.

### 2.11.3 Land Use Planning

The land use planning activities within the overview planning areas are on three levels: local ( such as city or township ),


HOLLY
GROVELAND
BRANDON
OXFORD
ADDISON
Leonard
BRUCE
ARMADA
RICHMOND
SPRINGFIELD
INDEPENDENCE
ORION
OAKLAND
WASHINGTON
RAY
MACOMB
PONTIAC
ROCHESTER
SHELBY
WHITE LAKE
WATERFORD
AVON
OAKLAND
MACOMB
COMMERCE
MILFORD
WEST BLOOMFIELD
BLOOMFIELD
TROY
900
500
600
700
500
LYON
OAKLAND
WAYNE
VAN BUREN
ROMULUS
TAYLOR
ALLEN PARK
LINCOLN PARK
ECORSE
RIVER ROUGE
WYANDOTTE
WINDSOR
Ontario, Canada
BROWNSTOWN
HURON
RIVERVIEW
TRENTON
WOODHAVEN
GROSSE ILE
FLAT ROCK
GIBRALTAR
DETROIT RIVER
SUMPTER
AUGUSTA
WAYNE

Note: Lines on map with equal values represent areas of equal dwelling unit intensity as on a topographic map presenting lines of equal elevation.

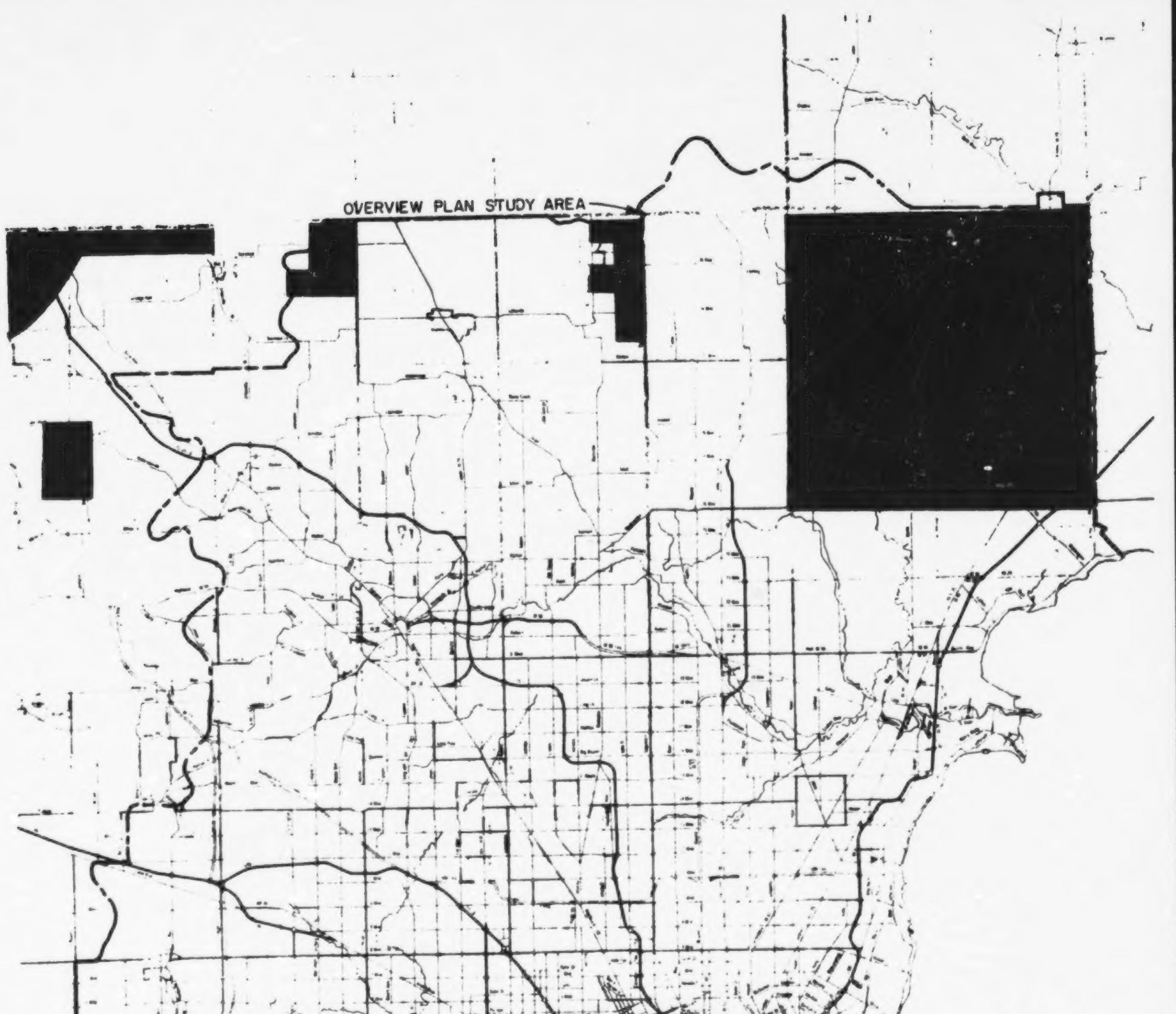
Figure 2.11-E

CONCENTRATIONS OF RESIDENTIAL LAND USE IN THE STUDY AREA

## Table 2.11-A

## Land Use Acreage
## Overview Plan Study Area, 1970

| | | | | Residential Density | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Com. | Ind. | Inst. | Low | Med. | High | Rec. | Cem. | Agr. | Vac. | Wat. | Ext. | ROW | R.R. | Total |
| Detroit | 5,913 | 8,627 | 5,056 | 5,039 | 34,716 | 11,712 | 6,980 | 1,048 | 82 | 2,230 | 235 | 98 | 5,988 | 788 | 88,512 |
| Balance of Wayne County | 3,799 | 6,319 | 6,473 | 40,972 | 5,853 | 1,503 | 8,643 | 721 | 12,872 | 45,782 | 505 | 626 | 5,130 | 981 | 140,179 |
| Oakland County | 5,399 | 3,839 | 7,971 | 78,189 | 6,765 | 144 | 14,414 | 2,920 | 73,936 | 162,152 | 17,815 | 4,204 | 9,383 | 1,105 | 388,236 |
| Macomb County | 3,327 | 12,816 | 6,518 | 51,256 | 1,899 | 1 | 11,087 | 591 | 128,441 | 87,544 | 1,082 | 2,600 | 6,984 | 724 | 314,870 |
| Total Overview Plan Study Area | 18,438 | 31,601 | 26,018 | 175,456 | 49,233 | 13,360 | 41,124 | 5,280 | 215,331 | 297,708 | 19,637 | 7,528 | 27,485 | 3,598 | 931,797 |


OVERVIEW PLAN STUDY AREA
CANTON TOWNSHIP
SUMPTER TOWNSHIP
N
0 1 2 3 6 9 12 15 18
Scale in Miles

NOTE: IN WAYNE COUNTY EACH TOWNSHIP HAS CONTROL OVER LAND USE POLICY. THE TOWNSHIPS INDICATED ON THE MAP ARE CURRENTLY INVOLVED IN DEVELOPING POLICIES CONCERNING CONSERVATION OF THEIR AGRICULTURAL LAND.

*Sources Lewellen, J. - District Conservationist, Wayne County, Michigan; Stacy, J. - District Conservationist, Oakland County, Michigan; Wilkinson, R. - District Conservationist, Wayne County, Michigan. The preceeding sources were obtained thru personal telephone conversation with Shannon Casey, Geologist, Black & Veatch, January 5, 1977.*

**PRIME AGRICULTURAL AREAS**
Figure 2.11-F

county, and regional. The regional planning agency, SEMCOG, is also the designated A-95 review agency and the 208 agency. SEMCOG has been very active in transportation, housing, and some land use planning activities. Regional plans, however, must be implemented by local planning agencies. Of the seventy-eight autonomous political jurisdictions in the overview planning area, twelve of the minor civil divisions did not have a planning or zoning commission as of 1972.

The extent to which plans have been implemented varies throughout the area. Some units have existing land use information, zoning, subdivision regulations, and master planning. Many units have implemented one or more of these plans but not all of them. Figures 2.11-G through 2.11-I present maps showing the units having master plans, subdivision regulations, and adopted zoning regulations. The zoning and subdivision regulations are generally accepted and carried out. However, variances are not difficult to obtain and most regulatory bodies are open to such proposals.

## 2.12 Cultural Resources

### 2.12.1 Archaeological Sites

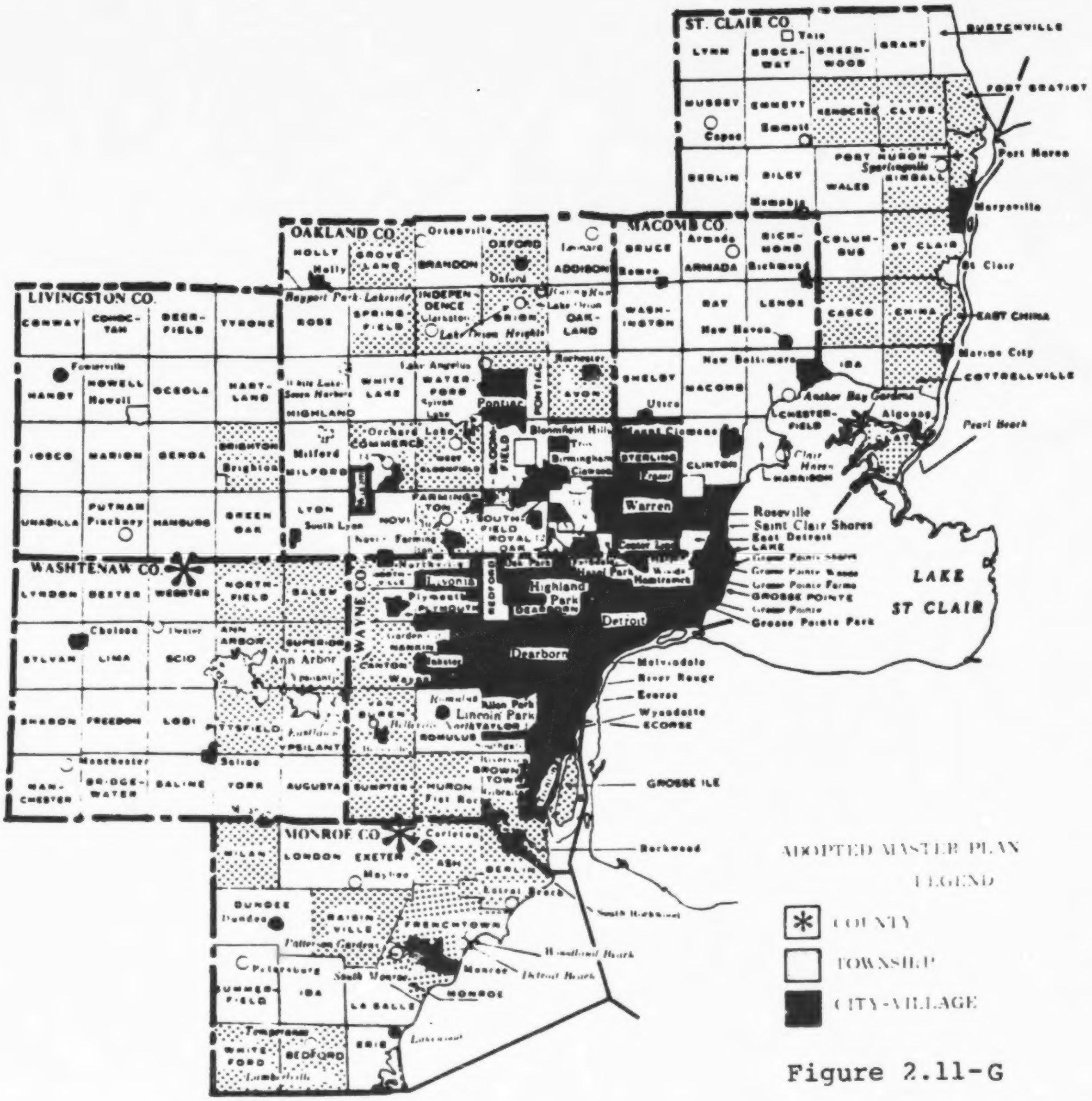
Four areas known to contain archaeological sites are present in the study area - one in Detroit, two in southern Macomb County, and one in northern Macomb County (Giffels/Black and Veatch, 1977, Book IV). There may have been numerous other archaeological sites in the study area that have been disrupted or concealed by urban sprawl.

The potential for discovery of additional sites is great. Numerous Indian trails, each miles in length, existed in the study area. The Potawatami Trail followed the Huron River. The Shiawassee and Saginaw Trails ran in a northwest to southeast direction through Oakland County and passed through the northeastern area of Wayne County and the City of Detroit. In addition, numerous other trails existed, many of which were related to streams and valleys.

### 2.12.2 Historical Sites

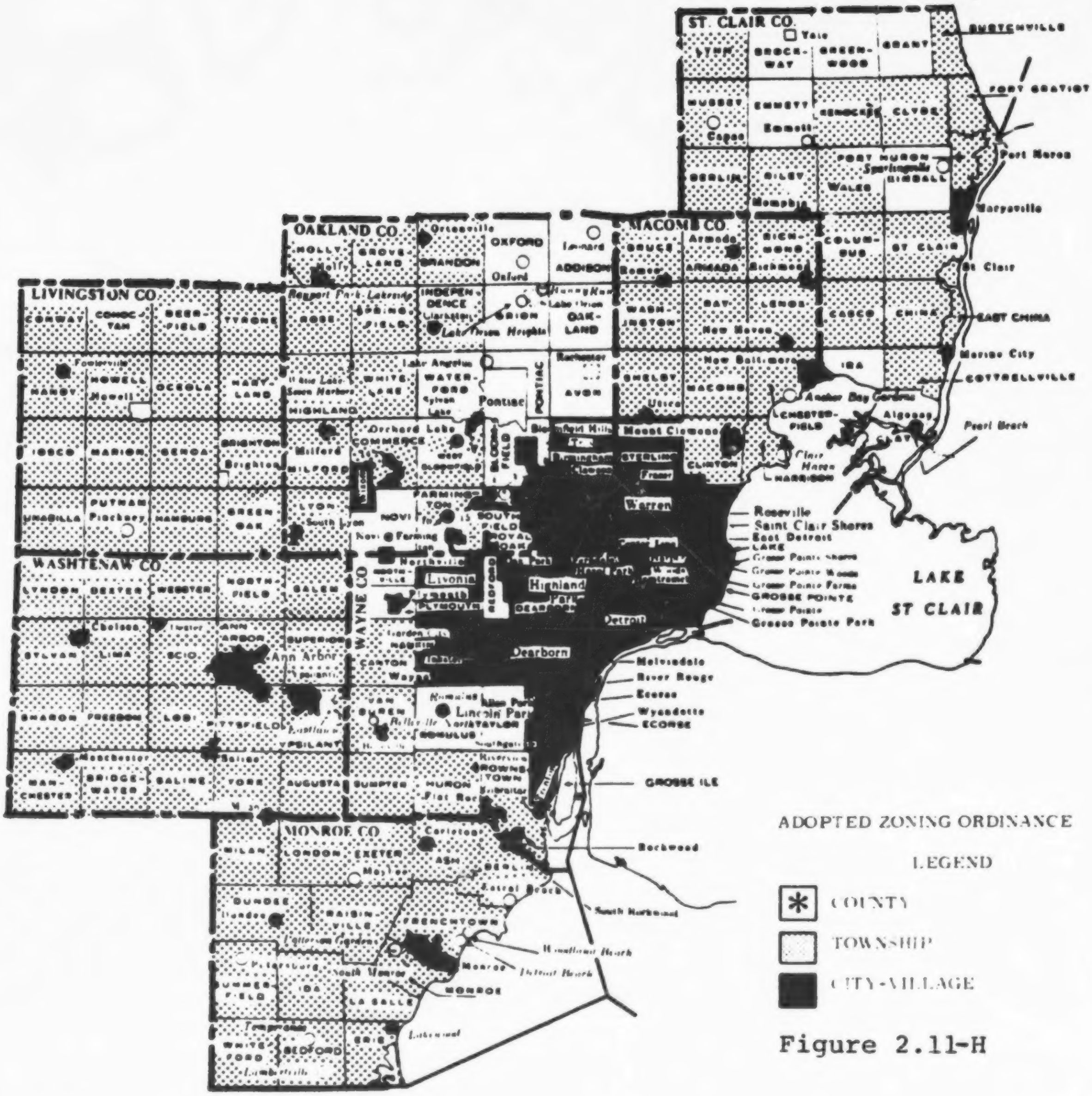
Numerous historical sites and landmarks exist in the study area (Figure 2.12-A, B). Table 2.12-A identifies the numbered landmarks. (For descriptions of these sites, see Giffels/Black and Veatch, 1977, Book IV). Inhabited prior to 1760, the area is rich in historical resources. Detroit was the territorial capital and the first state capital of Michigan.

Thirty-six registered National Historic Landmarks are within the city limits of Detroit. An additional four sites are in Wayne County, four in Macomb County, and ten in Oakland County. Additionally, eighty-two historic sites and landmarks are local historical sites (Giffels/Black and Veatch, 1977, Book IV).



ST. CLAIR CO.
OAKLAND CO.
MACOMB CO.
LIVINGSTON CO.
WASHTENAW CO.
WAYNE CO.
MONROE CO.
LAKE ST CLAIR
Detroit
Dearborn
Highland Park
Warren
Pontiac
Livonia
Lincoln Park
Ann Arbor
Roseville
Saint Clair Shores
East Detroit
GROSSE POINTE
GROSSE ILE
Port Huron
Marysville
St Clair
Marine City
MONROE
ADOPTED MASTER PLAN
LEGEND
COUNTY
TOWNSHIP
CITY-VILLAGE

Figure 2.11-G


ST. CLAIR CO.
OAKLAND CO.
MACOMB CO.
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WASHTENAW CO.
WAYNE CO.
MONROE CO.
LAKE ST CLAIR
Port Huron
Marysville
St Clair
Marine City
Pontiac
Warren
Roseville
Saint Clair Shores
East Detroit
Detroit
Dearborn
Highland Park
Livonia
Ann Arbor
Lincoln Park
GROSSE ILE
Rockwood
ADOPTED ZONING ORDINANCE
LEGEND
COUNTY
TOWNSHIP
CITY-VILLAGE

Figure 2.11-H

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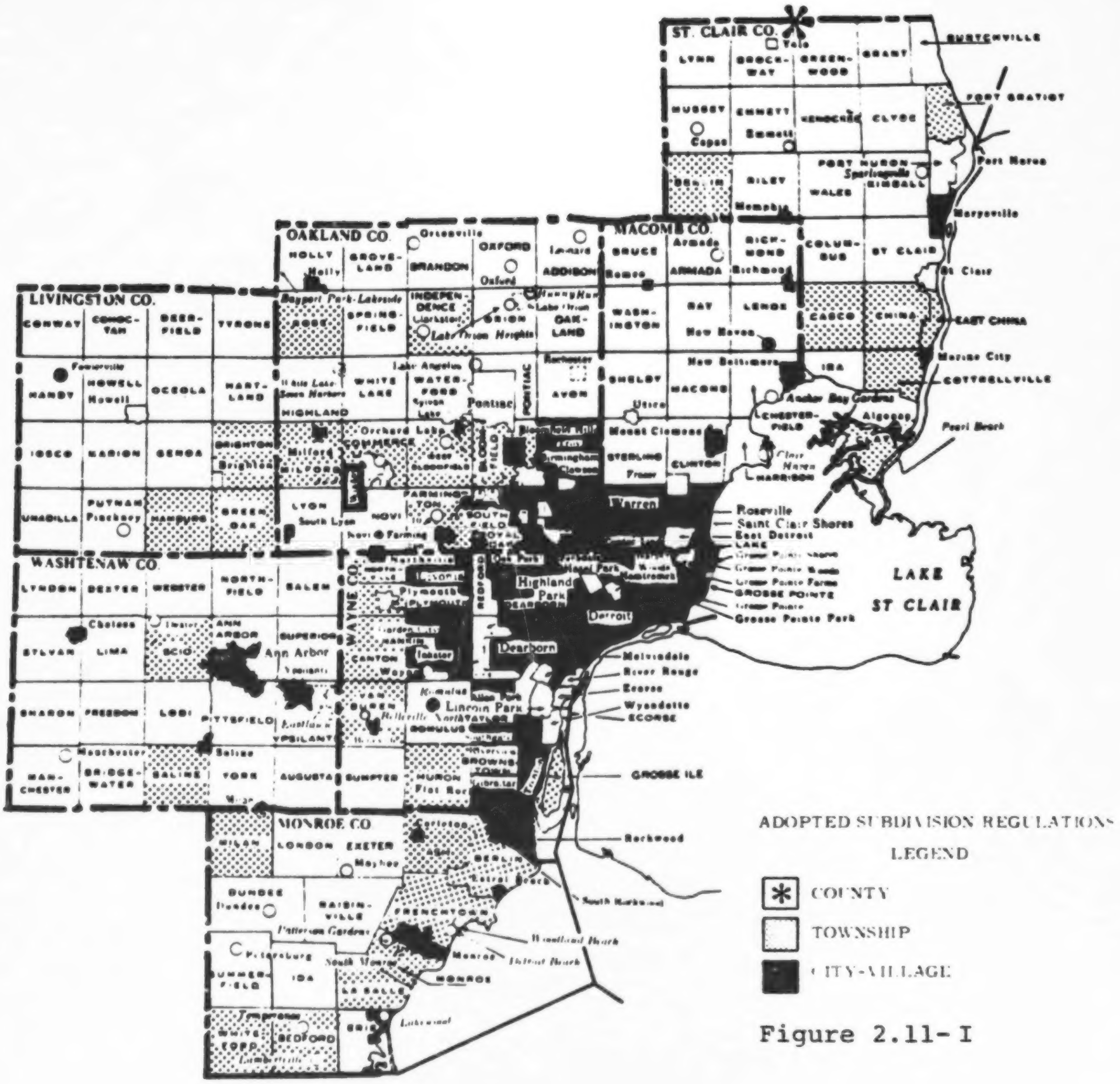
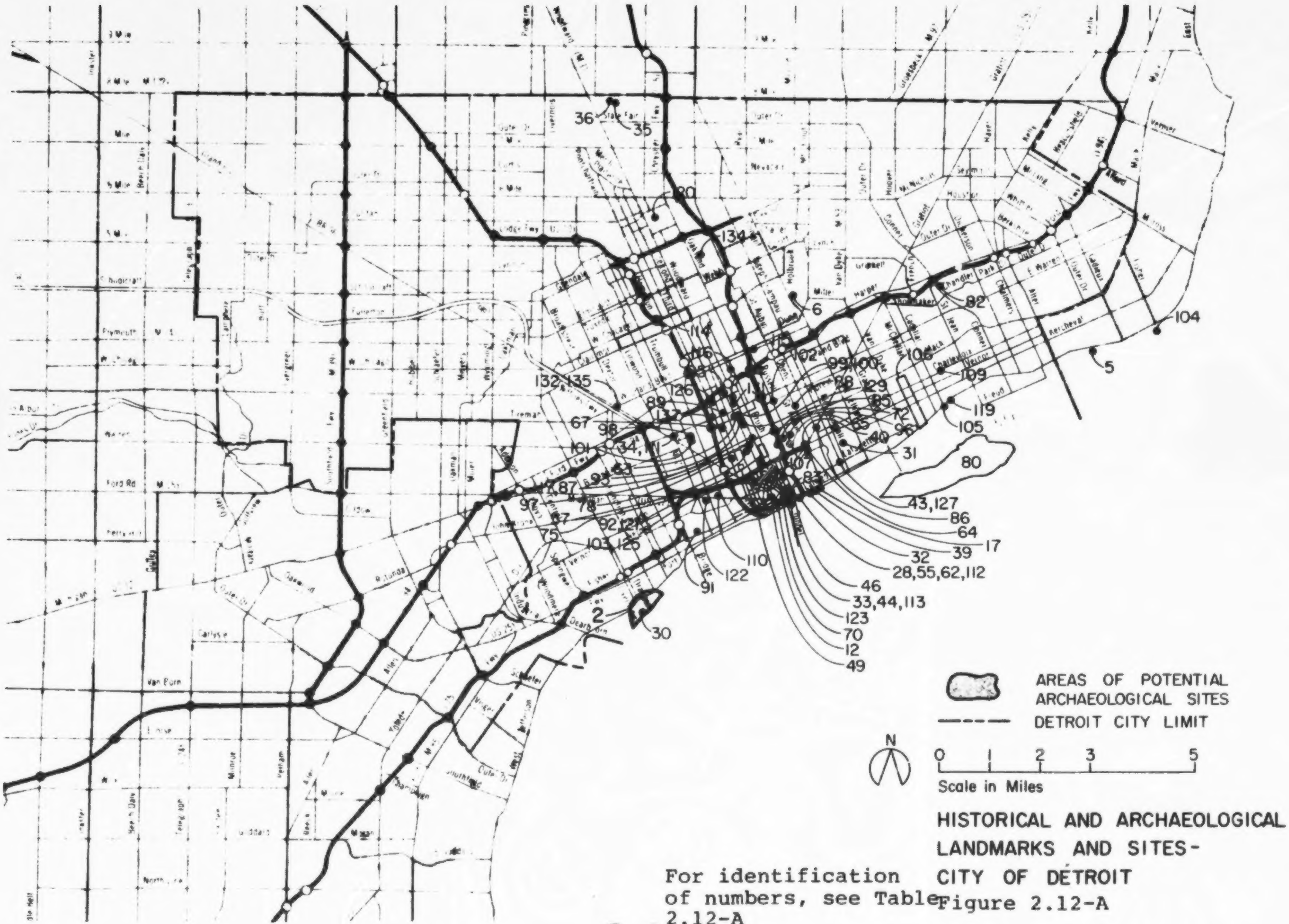
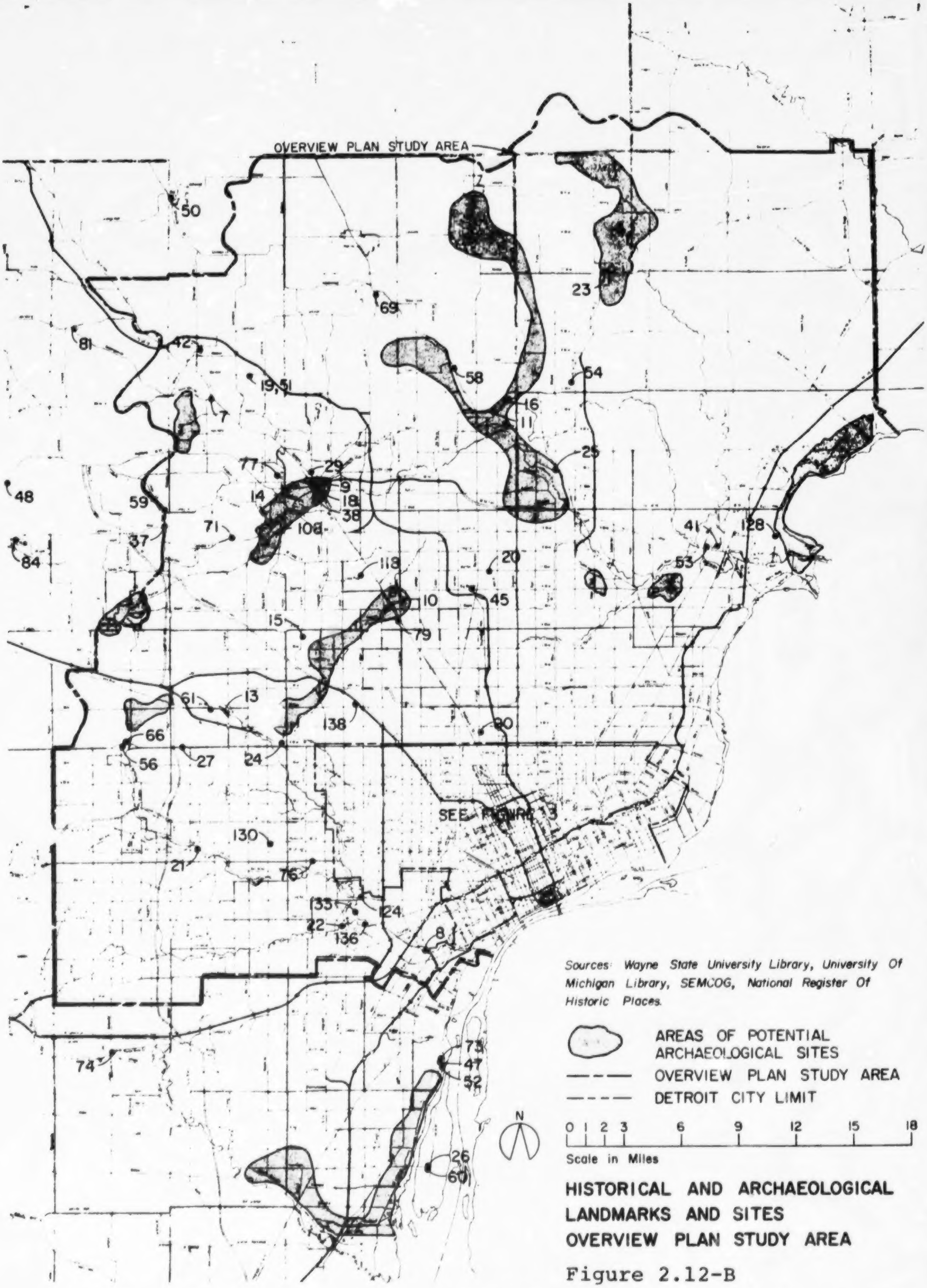

ST. CLAIR CO.
OAKLAND CO.
MACOMB CO.
LIVINGSTON CO.
WASHTENAW CO.
WAYNE CO.
MONROE CO.
LAKE ST CLAIR
Pontiac
Warren
Highland Park
Detroit
Dearborn
Lincoln Park
Ann Arbor
Roseville
Saint Clair Shores
East Detroit
GROSSE POINTE
Grosse Pointe Park
Melvindale
River Rouge
Ecorse
Wyandotte
GROSSE ILE
Rockwood
Port Huron
Marysville
St Clair
EAST CHINA
Marine City
COTTRELLVILLE
BURTCHVILLE
FORT GRATIOT
ADOPTED SUBDIVISION REGULATIONS
LEGEND
✱ COUNTY
▨ TOWNSHIP
■ CITY-VILLAGE

Figure 2.11- I


36
35
120
134
6
82
104
5
116
115
102
99,100
106
109
119
105
132,135
126
89
137
129
85
67
98
101
34,111
96
31
80
87
63
93
97
78
57
92
121
75
103
125
107
83
43,127
86
64
17
39
32
28,55,62,112
110
122
91
46
33,44,113
123
70
12
49
2
30
AREAS OF POTENTIAL ARCHAEOLOGICAL SITES
DETROIT CITY LIMIT
N
0
1
2
3
5
Scale in Miles

HISTORICAL AND ARCHAEOLOGICAL LANDMARKS AND SITES-
CITY OF DETROIT
Figure 2.12-A

For identification of numbers, see Table 2.12-A


OVERVIEW PLAN STUDY AREA
50
23
69
81
42
58
54
19,51
7
16
11
25
77
29
9
18
38
14
108
48
59
71
37
84
41
128
53
20
118
45
10
15
79
61
13
66
138
80
56
27
24
SEE FIGURE 13
130
21
76
133
124
22
136
8
73
47
52
74
26
60
AREAS OF POTENTIAL ARCHAEOLOGICAL SITES
OVERVIEW PLAN STUDY AREA
DETROIT CITY LIMIT
N
0 1 2 3 6 9 12 15 18
Scale in Miles

*Sources: Wayne State University Library, University Of Michigan Library, SEMCOG, National Register Of Historic Places.*

HISTORICAL AND ARCHAEOLOGICAL LANDMARKS AND SITES OVERVIEW PLAN STUDY AREA

Figure 2.12-B

For identification of numbers, see Table 2.12-A

Table 2.12-A

## Historical Sites and Landmarks
## Post American Revolution

| Landmark | Key |
|---|---|
| Seitz House | 5 |
| Hamtramck, Colonel John F. (Landmark) | 6 |
| Waterford Township Historic District | 7 |
| Reves-Wilhelm Cemetery | 8 |
| First Baptist Church | 9 |
| *Hunter, John W., House | 10 |
| *Stony Creek Village Historic District | 11 |
| Michigan's First Capitol | 12 |
| *Farmington Historic District | 13 |
| First Presbyterian Church | 14 |
| *Franklin Historic District | 15 |
| Winkler's Mill | 16 |
| *Trowbridge House | 17 |
| First Methodist Episcopal Church | 18 |
| Sashabaw Cemetery | 19 |
| Caswell House | 20 |
| Newburgh Cemetery | 21 |
| *Commandant's Quarters | 22 |
| *Romeo Historic District | 23 |
| Botsford Inn | 24 |
| *Clinton-Kalamazoo Canal | 25 |
| *East River Road Historic District | 26 |
| *Greenmead Farms (Simmons House) | 27 |
| *Sts. Peter and Paul Church | 28 |
| *Wisner House (Pine Grove) | 29 |
| *Fort Wayne | 30 |
| Elmwood Cemetery | 31 |
| *Sibley House | 32 |
| *Mariner's Church | 33 |
| Harmonie Club (Site) | 34 |
| Michigan State Fair | 35 |
| Grant, U.S., House | 36 |
| Byers Farm | 37 |
| *Myrick-Palmer House | 38 |
| *Moross House | 39 |
| Eastern Market Historic District | 40 |
| Chevalier Home (Crocker House) | 41 |
| Clarkston Historic District | 42 |
| Champlain Street Cemetery of Temple Beth El | 43 |
| Trombly (Beaubian) House | 44 |
| *Brooks Farm | 45 |
| *Monroe Avenue Commercial Bldgs. | 46 |
| Eureka Iron Works | 47 |
| *Rowe House | 48 |
| *Fort Street Presbyterian Church | 49 |

Table 2.12-A (continued)

| | |
|---|---|
| *Ortonville Mill | 50 |
| Sashabaw United Presbyterian Church | 51 |
| Marx House | 52 |
| Mount Clemens RR Station | 53 |
| *Washington Octagon House | 54 |
| *Christ Church, Detroit | 55 |
| *Northville Historic District | 56 |
| Masonic Temple of Zion Lodge No. 1, F. & A.M. | 57 |
| Goodison House | 58 |
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* Represents site and landmarks listed in the National Register of Historic Places.

### 2.12.3 Recreation

Land preserved for recreation falls basically into two groups: suburban parks intended for intensive use and rural parks usually for extensive or passive recreation. A significant acreage is dedicated to parks, particularly in the outlying areas (Figure 2.12-C). Analysis of the 1990 Regional Recreation and Open Space Plan indicates that the City of Detroit has inadequate recreational facilities and local parks in relation to the distribution of its large population. There is limited open space within easy driving distance for residents of Detroit and its inner suburbs. Deficiencies in the open space plan as of present have been identified by the facilities planning consultant.

Within the City of Detroit, parks are located along the shoreline and on islands in the Detroit River and along the River Rouge. Other recreational land is scattered throughout the area. Sports arenas are located in Pontiac (football) and Detroit (hockey, baseball, basketball). A proposed sports arena is planned along the Detroit River.

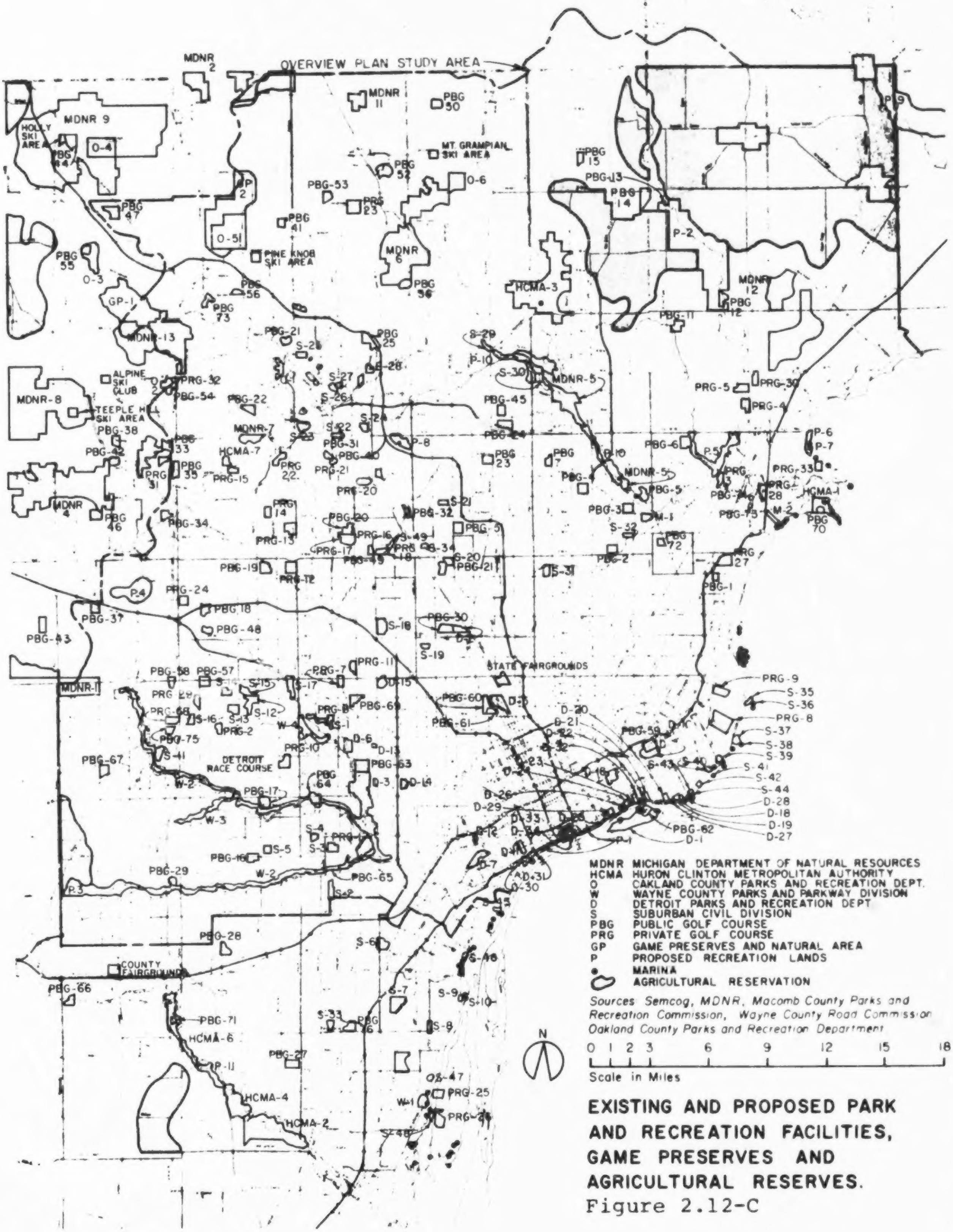
### 2.12.4 Cultural

Regional cultural centers (libraries, museums, galleries, theaters, and concert halls) are almost exclusively located in the City of Detroit (Figure 2.12-D). The major cultural center of the city is Wayne State University along Woodward Avenue. Dearborn, Bloomfield Hills, Avon, Independence, Pontiac, and Southfield are the only other communities with regional cultural centers.

Several ethnic churches are located near the DWWTP: the First Hungarian Lutheran Church, St. John Cantius Catholic Church, and St. John the Baptist Byzantine Catholic Church. The residential area adjacent to the DWWTP is a European neighborhood, predominantly Hungarian, which has undergone adverse changes due to the encroachment of the industrial sector, the DWWTP, and highway construction.

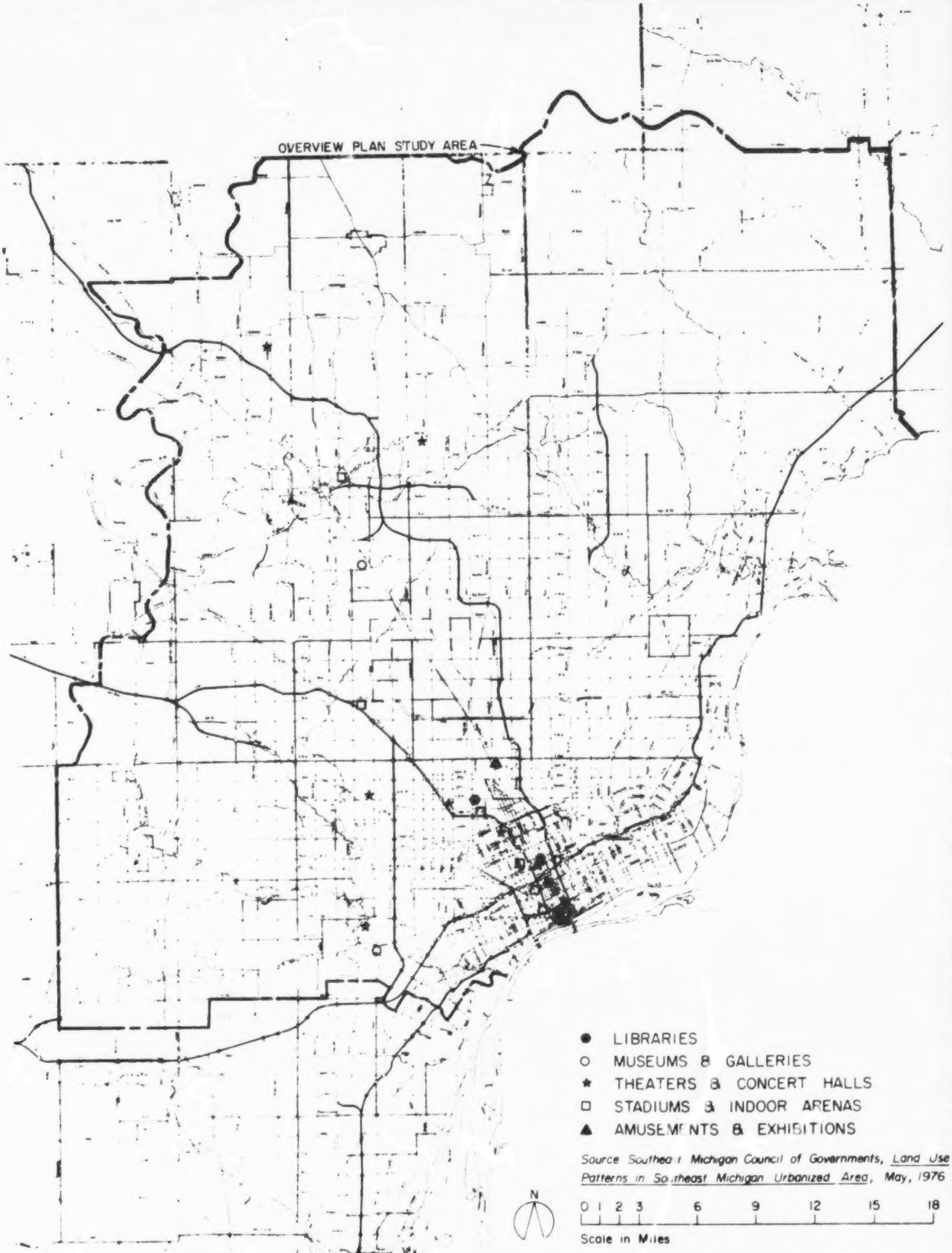
### 2.13 Employment

Data available for the decade of the 1960's within the three county area shows a decline in total employment in the primary metals category of the export sector (-1.0%). Wayne County statistics are demonstrative of the shift in employment location. During this decade, Wayne County recorded declines in total employment in four manufacturing categories: machinery, primary metals, chemicals, and other manufacturing. Conversely, neither Oakland nor Macomb County registered a net loss in any category from 1960-1970 (Giffels/Black and Veatch, 1977, Book V).


OVERVIEW PLAN STUDY AREA
HOLLY SKI AREA
MDNR 9
MDNR 2
MDNR 11
PBG 50
MT. GRAMPIAN SKI AREA
PINE KNOB SKI AREA
ALPINE SKI CLUB
TEEPLE HILL SKI AREA
MDNR 6
MDNR-8
MDNR-13
MDNR 4
HCMA-3
MDNR 12
MDNR-5
HCMA-7
HCMA-1
STATE FAIRGROUNDS
DETROIT RACE COURSE
COUNTY FAIRGROUNDS
MDNR-1
HCMA-6
HCMA-4
HCMA-2
MDNR MICHIGAN DEPARTMENT OF NATURAL RESOURCES
HCMA HURON CLINTON METROPOLITAN AUTHORITY
O OAKLAND COUNTY PARKS AND RECREATION DEPT.
W WAYNE COUNTY PARKS AND PARKWAY DIVISION
D DETROIT PARKS AND RECREATION DEPT.
S SUBURBAN CIVIL DIVISION
PBG PUBLIC GOLF COURSE
PRG PRIVATE GOLF COURSE
GP GAME PRESERVES AND NATURAL AREA
P PROPOSED RECREATION LANDS
● MARINA
AGRICULTURAL RESERVATION
Sources: Semcog, MDNR, Macomb County Parks and Recreation Commission, Wayne County Road Commission, Oakland County Parks and Recreation Department
N
0 1 2 3 6 9 12 15 18
Scale in Miles

**EXISTING AND PROPOSED PARK AND RECREATION FACILITIES, GAME PRESERVES AND AGRICULTURAL RESERVES.**

Figure 2.12-C


OVERVIEW PLAN STUDY AREA
● LIBRARIES
○ MUSEUMS & GALLERIES
★ THEATERS & CONCERT HALLS
☐ STADIUMS & INDOOR ARENAS
▲ AMUSEMENTS & EXHIBITIONS
N
0 1 2 3 6 9 12 15 18
Scale in Miles

*Source Southeast Michigan Council of Governments, Land Use Patterns in Southeast Michigan Urbanized Area, May, 1976*

**MAJOR CULTURAL CENTERS**
Figure 2.12-D

Overall, total employment increased in the study area from 1960 to 1970 (1,044,261 to 1,373,361) (Table 2.13-A). A further breakdown shows the export sector increased from approximately 376,000 to 417,000, and the domestic sector increased from 668,000 to 956,500. The domestic sector was supporting the growth of the region during this decade with the greatest gains registered by the services, retail trade, and government categories. The total increase in employment by these categories was approximately 215,000.

## 2.14 Public Health

The public health "condition" is usually measured in terms of the incidence of communicable diseases. The occurrence of disease pathogens depends on many uncontrollable factors, but the degree to which they flourish is largely a function of environmental conditions. Viral diseases such as measles, rubella, and mumps are spread by personal contact and therefore high population densities are more susceptible to these communicable diseases. Proliferation of such diseases such as hepatitus, salmonella, typhoid, and dysentery are caused by bacteria and are generally a result of improper sanitary conditions, improper preparation of food, and water contaminated by fecal matter.

TABLE 2.14-A

INCIDENCE OF COMMUNICABLE DISEASE
CASES PER 1000 POPULATION

| Year | Detroit City | Three County Area | Seven County Region | State of Michigan |
|---|---|---|---|---|
| 1975 | 10.9 | 5.7 | 5.9 | 8.1 |
| 1974 | 11.5 | 6.6 | 6.5 | 8.6 |
| 1973 | 13.1 | 7.0 | 6.8 | 8.0 |
| 1972 | 10.1 | 5.4 | 5.1 | 5.7 |
| 1971 | 9.8 | 6.2 | 5.9 | 6.2 |
| 1970 | 10.5 | 5.7 | 5.5 | 5.7 |

Records of communicable diseases (Table 2.14-A) show an increase until 1974 of all major communicable diseases (salmonella, dysentery, hepatitis, and typhoid) (Giffels/Black and Veatch, 1977, Book V). The records since then show a decrease in incidence of disease. Generally, factors such as personal and family hygiene, drug use, increased reporting and surveillance of disease tend to make interpretations of these data difficult.

## TABLE 2.13-A

## HISTORICAL EMPLOYMENT BY PLACE OF WORK, 1960 - 1970

| | 1960 | | | | | 1970 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Industry | Wayne | Oakland | Macomb | Overview Plan Study Area | Seven-County Region | Wayne | Oakland | Macomb | Overview Plan Study Area | Seven-County Region |
| **Export** | | | | | | | | | | |
| Motor Vehicles | 127,770 | 31,234 | 24,102 | 183,106 | 212,619 | 131,037 | 36,687 | 33,734 | 201,458 | 235,044 |
| Machinery | 52,405 | 12,203 | 10,976 | 75,584 | 86,913 | 48,347 | 24,554 | 15,383 | 88,284 | 98,868 |
| Primary Metals | 39,282 | 2,334 | 3,433 | 45,049 | 54,169 | 37,382 | 3,134 | 4,077 | 44,593 | 54,084 |
| Fabricated Metals | 39,199 | 5,520 | 9,549 | 54,268 | 61,812 | 39,829 | 7,925 | 16,433 | 64,187 | 73,542 |
| Chemicals | 16,119 | 1,590 | 519 | 18,228 | 21,252 | 14,096 | 1,959 | 2,195 | 18,250 | 21,638 |
| Total Export Employment | 274,775 | 52,881 | 48,579 | 376,235 | 436,765 | 270,691 | 74,259 | 71,822 | 416,772 | 483,176 |
| **Domestic** | | | | | | | | | | |
| Other Manufacturing | 70,403 | 7,983 | 13,289 | 91,675 | 115,146 | 64,543 | 14,418 | 15,969 | 94,930 | 125,477 |
| Services and Other | 109,524 | 17,253 | 6,498 | 133,275 | 146,930 | 140,107 | 45,382 | 19,423 | 204,912 | 225,241 |
| Transportation, Communication and Other Utilities | 44,686 | 5,990 | 2,184 | 52,860 | 64,733 | 51,905 | 10,167 | 3,908 | 65,980 | 79,494 |
| Government | 87,458 | 19,048 | 14,396 | 120,902 | 134,005 | 126,768 | 39,597 | 29,035 | 195,400 | 216,999 |
| Contract Construction | 26,662 | 8,394 | 3,384 | 38,440 | 45,762 | 29,507 | 17,698 | 6,667 | 53,872 | 62,676 |
| Finance, Insurance and Real Estate | 34,976 | 2,524 | 744 | 38,244 | 44,942 | 51,055 | 9,050 | 2,147 | 62,252 | 73,416 |
| Wholesale Trade | 42,716 | 4,838 | 2,161 | 49,715 | 57,084 | 52,593 | 10,978 | 4,765 | 68,336 | 77,714 |
| Retail Trade | 109,896 | 24,532 | 8,487 | 142,915 | 170,203 | 138,329 | 49,596 | 22,982 | 210,907 | 250,546 |
| Total Domestic Employment | 526,321 | 90,562 | 51,143 | 668,026 | 778,805 | 654,807 | 196,886 | 104,896 | 956,589 | 1,111,563 |
| Total Employment | 801,096 | 143,443 | 99,722 | 1,044,261 | 1,215,570 | 925,498 | 271,145 | 176,718 | 1,373,361 | 1,594,739 |
| Per Cent of Study Area | 76.7 | 13.7 | 9.6 | 100.0 | | 67.4 | 19.7 | 12.9 | 100.0 | |

## 2.15 Public Facilities and Services

Major capital investment in various infrastructure components is generally known to affect the attractiveness of an area to residential, commercial, and industrial location. In addition, the growth of any sector generates additional demand for services. As such, this section will present existing facilities, their service capacity, and proposed plans for expansion of service.

### 2.15.1 Transportation Facilities

Major freeways in the study area are I-94, I-696, I-75, I-96, M-53, and M-59 in addition to many other important arterial routes (Giffels/Black and Veatch, 1977, Book IV). Transportation in the study area is strongly dependent upon the private and pooled automobile.

Planned and future expansion of the highway network includes:

- North and south extensions of M-53,
- Extension of M-59 north,
- Connection of I-75 with US-10, I-96 and I-696,
- Completion of I-96, and
- Completion of M-14.

Highways under construction include:

- I-696 from I-75 north to I-96, and
- I-96 west to I-696.

Public transportation facilities include bus, rapid transit rail service, and trolley. The Southeastern Michigan Transportation Authority (SEMTA), created in 1967, has been directed to plan, acquire, construct, operate and contract for transportation facilities in the three county area. Within the DWSD service area, the following is provided:

- Bus service radiating out from downtown Detroit,
- DASH (direct access shuttle) service to major employment centers,
- Park and ride service from suburban locations to cultural events within the metropolitan area, and
- Operation of the Grand Trunk and Western commuter rail service between Detroit central city and Pontiac.

Present identifiable plans call for upgrading and expansion of the present systems, implementation of rapid transit systems to the outlying counties and an automated people mover system in the Detroit CBD.

In addition, AMTRAK provides commuter service west to Ann Arbor and on to Chicago through Jackson. Service to the eastern cities of Buffalo and New York is also provided.

Freight traffic is presently carried on approximately 500 miles of rail within the DWSD service area. The three major campanies holding the vast majority of the rights-of-way are Conrail, Grand Trunk and Western, and the Chesapeake and Ohio railroads. Four major public airports serve the DWSD service area.

### 2.15.2 Educational Facilities

Educational facilities include primary and secondary schools operated by the public and private sector. Higher education is available from both academic and technical schools.

Total school enrollment in the three counties declined from 1971 to 1975 with some school closings in the Detroit public school system (Giffels/Black and Veatch, 1977, Book IV). Western Wayne County and northern Macomb County show an increased enrollment paralleling the change in land use from agricultural to industrial. A recurring problem is inequitable enrollment distribution necessitating construction of new schools in suburban areas while reserve capacity exists in others, particularly in the City of Detroit and older residential sections of Wayne and Macomb Counties. Projections by the Michigan Department of Education show a 12% or greater loss in school enrollments for Macomb, Oakland, and Wayne Counties for 1977-1982 (Hecker and Ignatovich, 1977).

### 2.15.3 Health Facilities

Within the study area, there are 84 hospitals with a 18,939 bed capacity, 167 nursing care facilities with a 20,931 bed capacity, and 42 homes for the aged with a capacity of 3,684 beds (Giffels/Black and Veatch, 1977, Book IV). These facilities are concentrated in Detroit.

Beds per 1000 population are highest in Detroit and lowest in Oakland County. Beds per thousand population have been increasing in Detroit, decreasing in Wayne (excluding Detroit) and Oakland Counties, and remaining approximately even in Macomb County.

Comparison of the Detroit health care facilities and professional staff with national statistics shows that decreases in the number of hospital beds/thousand population are a national trend. Health care facilities are considered adequate for the duration of the planning period.

### 2.15.4 Fire and Police Protection

Fire protection is provided by local units of government. The number of fire stations in Detroit has decreased since 1970, while the number of firefighters per 100,000 population has increased slightly. Personnel in the three county area have increased from 1972 to 1975 and the number of volunteer units has decreased (Giffels/Black and Veatch, 1977, Book IV). The City of Detroit has a fire insurance rating similar to other large cities in the nation.

Police protection is provided by separate municipal departments, the respective County Sheriff's Departments, and the Michigan State Police. Law enforcement personnel per 1000 population are most numerous in Detroit and least numerous in Macomb County.

### 2.15.5 Water Service

The largest supplier of domestic treated water is DWSD. Twenty-one additional suppliers of treated water exist in the study area. The DWSD water treatment facilities have adequate capacity at present. The Huron treatment facility has sufficient reserve capacity to provide the additional needed water supply if it is expanded to its ultimate design capacity of 1200 mgd (4,542,000 $m^3$/d). No water distribution problems have occurred or are foreseen.

Many areas also rely upon private wells outside of the densely populated urban areas (Giffels/Black and Veatch, 1977, Book IV). Groundwater demand is projected to decrease from the 44 mgd (166,540 $m^3$/d) demand in 1970 to 39 mgd (147,615 $m^3$/d) in 2020.

### 2.15.6 Sewerage Service

Sewage collection service is provided by numerous authorities. Sewage treatment in the study area is provided almost entirely by DWSD. Ten suburban communities provide treatment facilities in addition to collection (Giffels/Black and Veatch, 1977, Book IV). This is covered in great detail in later sections of this report.

### 2.15.7 Energy Supply

Detroit Edison produces and provides electricity to the study area. Pontiac purchases this energy and retails electrical power to city residents. Detroit's Public Lighting Department generates some power and purchases the remainder from Detroit Edison (Giffels/Black and Veatch, 1977, Book IV).

The majority of the electrical energy is generated at coal-fired and other fossil fueled power plants. One nuclear power plant supplies some power to the region. Power generating capacity is adequate for the present.

No blackouts have occurred although brown-outs occurred during the 1977 winter due to fuel handling difficulties at the coal fired power plants.

Natural gas is supplied by Consumers Power Company, Michigan Consolidated Gas Company, and the Southeastern Michigan Gas Company. All of the gas companies have restricted supplies. The first two companies extend new connections to only residential and/or other essential needs. The other company has not accepted any new customers since 1974 (Giffels/Black and Veatch, 1977, Book IV).

### 2.15.8 Solid Waste Disposal

Solid wastes are presently incinerated and/or landfilled. Within the three county area, landfills have a design capacity of 2600 tons/day (Giffels/Black and Veatch, 1977, Book XII). Both the refuse hauling operations and the sanitary landfills are operated either privately or publicly.

SEMCOG projections of solid waste disposal requirements show a steadily increasing volume of wastes and diminishing landfill capabilities. Significant problems in solid waste disposal are anticipated with the existing short-term planning.

## 2.16 Summary

This chapter presents the existing natural and human environment of the study area. This information is used as a baseline for predicting the quality of the future environment, choosing feasible alternatives, and selecting a recommended plan compatible with the environment.

## 3.0 EXISTING FACILITIES

The following chapter presents the existing facilities for collection and treatment of wastewater within the study area. The facilities in the study area are presented in more detail than in the overview area due to the study requirements. This inventory of the existing systems will provide the foundation for any future requirements.

The wastewater collection system is presented in two parts: the City of Detroit system and the suburban systems. As the system is described and explained, it is evaluated on its capabilities to provide needed services. Operation and maintenance of the collection system is also described and evaluated.

Wastewater flows from the collection system to the regional Detroit Wastewater Treatment Plant (DWWTP) are described and analyzed. The wastewater flows are categorized by the source and type of wastewater (industrial or domestic).

The majority of this discussion was extracted from the SFP (Giffels/Black and Veatch, 1977, Book VII and Book XI).

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# 3.0 EXISTING FACILITIES

## 3.1 Wastewater Collection System

### 3.1.1 City of Detroit

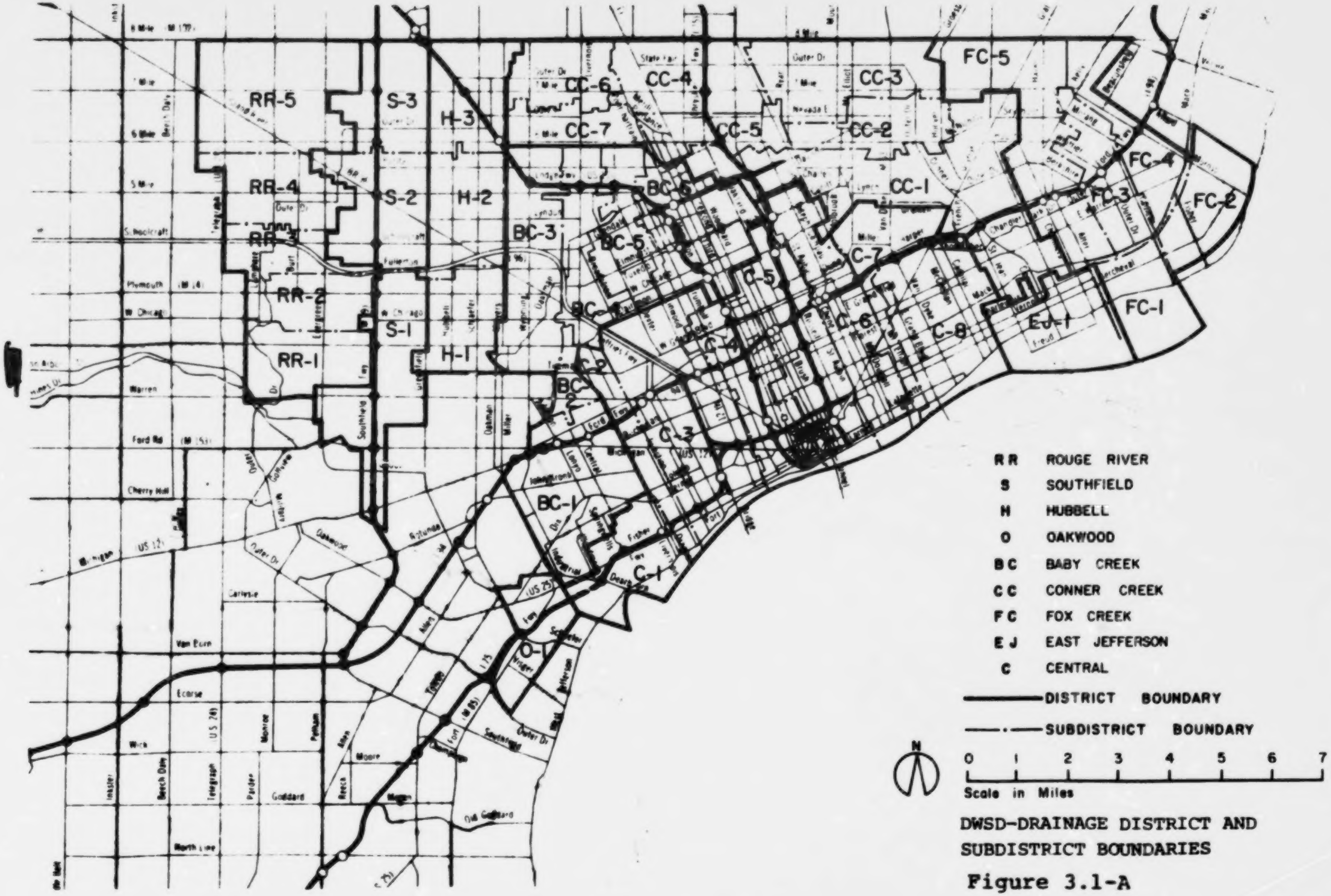
Collection of wastewater within the City of Detroit began in 1836. As the city grew, more laterals and combined collectors were built to convey the wastewater directly into the Detroit and Rouge Rivers. In 1914 the East Jefferson Avenue sewer was constructed to protect the city's raw water intake, and in 1926, the Detroit River Interceptor was started to intercept the collecting sewers.

Presently, the Detroit City collection system is a combined sewer system with approximately 89 percent (89%) of the existing sewers carrying both sanitary and storm water flow. The combined sewer system is divided into nine drainage districts (Figure 3.1-A) and are described in Table 3.1-A.

Baby Creek
Central
Conner Creek
East Jefferson
Fox Creek
Hubbell
Oakwood
Rouge River
Southfield

These nine districts are further divided into a total of 39 subdistricts. All of the major trunk sewers in these districts and subdistricts are connected in some manner to one of the two existing interceptors, the Detroit River Interceptor (DRI) and Oakwood-Northwest, which transport sanitary flow and a portion of storm flows to the DWSD Wastewater Treatment Plant. A third interceptor, the North Interceptor-East Arm (NI-EA) is currently under construction and is intended to operate in a similar manner providing relief to the DRI and conveying suburban flows.

Provisions have been made in some of the major trunk sewers within the collection system for containment of storm flows in excess of the existing interceptor capacities for subsequent discharge to the two receiving interceptors. Due to the relatively flat topography of the Detroit area, the major combined sewers were constructed with large cross sectional areas and on flat grades in the lower reaches; this created the potential for considerable in-system storage. In-system storage is achieved through the use of regulators, fabridams, and control gates.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EJ-1
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C-5
C-6
C-7
C-8
O-1
RR ROUGE RIVER
S SOUTHFIELD
H HUBBELL
O OAKWOOD
BC BABY CREEK
CC CONNER CREEK
FC FOX CREEK
EJ EAST JEFFERSON
C CENTRAL
DISTRICT BOUNDARY
SUBDISTRICT BOUNDARY
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Scale in Miles

DWSD-DRAINAGE DISTRICT AND SUBDISTRICT BOUNDARIES

Figure 3.1-A

TABLE 3.1-A Drainage Districts Within the City of Detroit

| Drainage District | Number of Subdistricts | Area in Acres | Population | Discharge to Major Interceptor | Number of Overflow Points |
|---|---|---|---|---|---|
| Baby Creek | 6 | 14,900<br>(6030 ha) | 257,000 | Oakwood Interceptor | 1 - through outfall sewer from Baby Creek Enclosure to River Rouge<br>2 - through the Livernois Relief sewer and the First Hamilton Relief sewer to the Detroit River |
| Central | 8 | 24,000<br>(9710 ha) | 414,000 | Detroit River Interceptor | 9 - through the 7 sewers in the District and excess flow through the First Hamilton Relief and the Conant - Mt. Elliott Relief sewers to the Detroit River. |
| Conner Creek | 7 | 18,000<br>(7280 ha) | 237,000 | Detroit River Interceptor | 3 - excess flow through the First Hamilton Relief, the Conant - Mt Elliott Relief and the Conner Creek sewer. |
| East Jefferson | 1 | 2,600<br>(1050 ha) | 61,300 | Detroit River Interceptor | 1 - excess combined sewage overflows through the Conner Creek backwater gate structure to the Detroit River via Conner Creek open channel. |
| Fox Creek | 5 | 11,400<br>(4474 ha) | 152,000 | Detroit River Interceptor | 1 - outfall sewer to Fox Creek which is tributary to the Detroit River. |
| Hubbell | 3 | 6,540<br>(2650 ha) | 87,000 | Northwest Interceptor | 2 - flows are directed to the Southfield sewer or to the River Rouge via the McNichols Relief, and Glendale sewers. |
| Oakwood | 1 | 1,500<br>(610 ha) | 17,000 | Oakwood-Northwest Interceptor | 1 - to the River Rouge. |
| River Rouge | 5 | 10,700<br>(4330 ha) | 124,000 | Northwest Interceptor | 6 - to the River Rouge. |
| Southfield | 3 | 8,000<br>(3240 ha) | 105,000 | Northwest Interceptor | 6 - to the River Rouge. |

When the combined sewers are unable to store or carry all the flow during the periods of storm runoff, the excess overflows to either the Detroit or the Rouge Rivers, or in some cases, basements and streets. There are approximately 82 overflow points along both the Detroit and the Rouge Rivers (Figure 3.1-B).

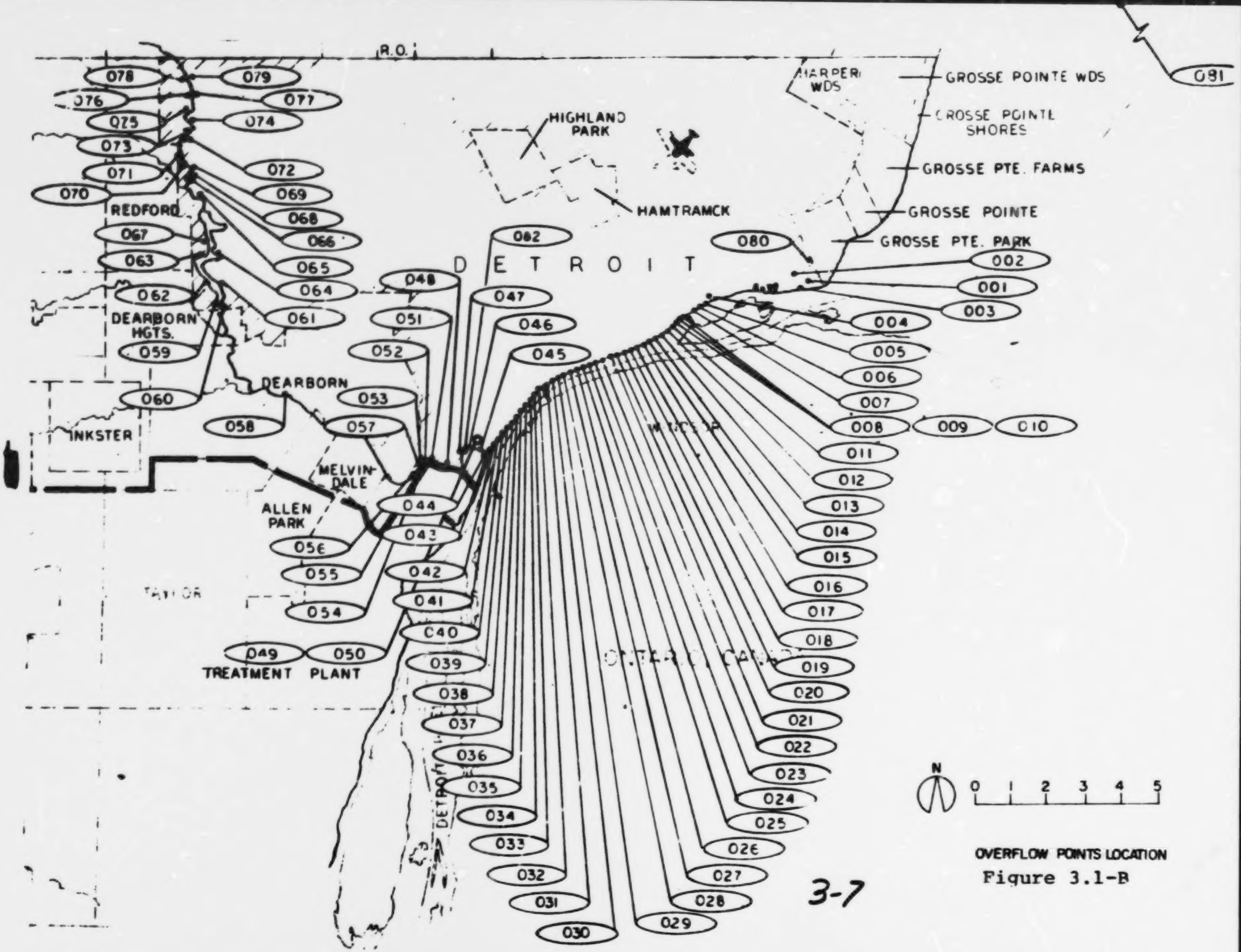
### 3.1.1.1 Combined Sewer System

Due to the size and complexity of the Detroit system, only the major trunk sewers were analyzed by Giffels/Black and Veatch (1977, Book VII). The existing major trunk sewers were analyzed by estimating their theoretical capacity and comparing it to estimated storm runoff from storms of 1, 5, and 10 year recurrence intervals. However, since the Northwest Interceptor has varying capacities which are due to widely varying pipes sizes and connections, and was not designed to carry storm flow, the Rouge River District was not analyzed. Estimated deficiencies in each subdistrict have been tabulated in Table 3.1-B.

The DRI theoretically has sufficient capacity to contain peak dry weather flow under existing conditions. An evaluation of the effect of the NI-EA on the DRI under existing conditions was performed. When placed into service, the NI-EA should alleviate the possible problem of restrictions during periods of peak dry weather flow in the lower reaches of the DRI when combined with a DRI relief sewer.

The existing theoretical capacity of the Oakwood-Northwest Interceptor is adequate for carrying dry weather flow except for a relatively short reach downstream of McNichols Road. There the peak flow rate exceeds existing theoretical capacity and dry weather overflows could occur in this area.

The present system for monitoring and controlling the wastewater collection system represents the culmination of efforts dating from 1966, when the DWSD assumed control of the wastewater facilities, to the present computerized system of data gathering and reporting. While still relying on an operator to assimilate available data from the collection system and make decisions as to the proper control procedures, the system is capable of providing: valuable data as a basis for future closed loop control in some areas; basic data for a preventive maintenance program of the collection system, and some of the basic raw data required to verify a mathematical model of the entire collection system which could be used to determine the flooding and overflow problem areas.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081
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055
056
049
050
REDFORD
DEARBORN HGTS.
DEARBORN
INKSTER
MELVIN-DALE
ALLEN PARK
TAYLOR
TREATMENT PLANT
DETROIT
HIGHLAND PARK
HAMTRAMCK
HARPER WDS
GROSSE POINTE WDS
GROSSE POINTE SHORES
GROSSE PTE. FARMS
GROSSE POINTE
GROSSE PTE. PARK
WINDSOR
ONTARIO, CANADA
DETROIT
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OVERFLOW POINTS LOCATION

Figure 3.1-B

## Table 3.1-B

## ESTIMATED DEFICIENCIES IN THE CITY OF DETROIT'S SUBDISTRICTS

| District | Subdistrict | Sewers | Deficiencies & (Excess Capacity) | | |
|---|---|---|---|---|---|
| | | | 1 Yr. Storm (cfs)* | 5 Yr. Storm (cfs)* | 10 Yr. Storm (cfs)* |
| Hubbell | H-1 | Hubbell | 200 | 1100 | 1500 |
| | H-2 | Hubbell | 300 | 1100 | 1400 |
| | H-3 | Hubbell | (100) | 500 | 700 |
| Southfield | S-1 | Southfield | 700 | 1500 | 1800 |
| | S-2 | Southfield | 400 | 800 | 1200 |
| | S-3 | Southfield | 0 | 500 | 700 |
| Oakwood | O-1 | Liddesdale | 500 | 1000 | 1300 |
| Baby Creek | BC-1 | Lonyo, Baby Creek Enclosure | (1700) | (200) | 0 |
| | BC-2 & 3 | Weatherby | 0 | 1600 | 1800 |
| | BC-4 | Joy | 500 | 1700 | 1800 |
| | BC-5 | Edison | 0 | 800 | 1200 |
| | BC-6 | Edison | (100) | 600 | 800 |
| Conner Creek | CC-1 | Conner Creek | (2500) | (2400) | (2000) |
| | CC-2 | McNichols | 200 | 300 | 400 |
| | CC-3 | 7-Mile | (400) | (300) | (200) |
| | CC-4 | 7-Mile | (400) | (300) | 0 |
| | CC-5 | McNichols | 100 | 200 | 300 |
| | CC-6 | 7-Mile | (500) | 0 | 0 |
| | CC-7 | McNichols | (300) | 0 | 0 |

* 1.0 cfs = 0.02832 $m^3/s$

## Table 3.1-B (continued)

## ESTIMATED DEFICIENCIES IN THE CITY OF DETROIT'S SUBDISTRICTS

| District | Subdistrict | Sewers | Deficiencies & (Excess Capacity)<br>1 Yr. Storm (cfs)* | <br>5 Yr. Storm (cfs)* | <br>10 Yr. Storm (cfs)* |
|---|---|---|---|---|---|
| Fox Creek | FC-3 | 3- Mile, Bedfore, Cadieux | (1000) | (200) | 200 |
| | FC-4 | Rivard | (500) | 800 | 1000 |
| | FC-5 | Ashland, Ashland Relief | (1600) | (600) | (200) |
| East Jefferson | EJ-1 | Jefferson Avenue East Relief | (1000) | 500 | 800 |
| | | Jefferson Avenue West Relief | (700) | 0 | 400 |
| Central | C-1 | Central, Martin | 0 | 600 | 800 |
| | C-2 | Morrell | (700) | (100) | 200 |
| | C-3 | Summit | (500) | 600 | 1300 |
| | C-4 | Third | 0 | 500 | 600 |
| | C-5 | Brush | (800) | 500 | 900 |
| | C-6 | Joseph Campau | (300) | 300 | 500 |
| | C-7 | Meldrum | 200 | 700 | 900 |
| | C-8 | Fisher | (700) | 0 | 400 |

Data gathered on flow levels, rain accumulation, overflows, gate and fabridam control, and flow metering are transmitted to the Systems Control Center. However, there are some problems with the accuracy of some of the data. Lack of proper maintenance is the principal performance problem with the level transmitters. There is no way to distinguish between an actual overflow condition or a loss of signal. The electrode relay sensors are proving less reliable than proximity switches from a maintenance standpoint. Little meaningful data are available from the two ultra-sonic type flowmeters presently in use. Their accuracy and long term performance is not yet known.

### 3.1.1.2 Pumping Stations

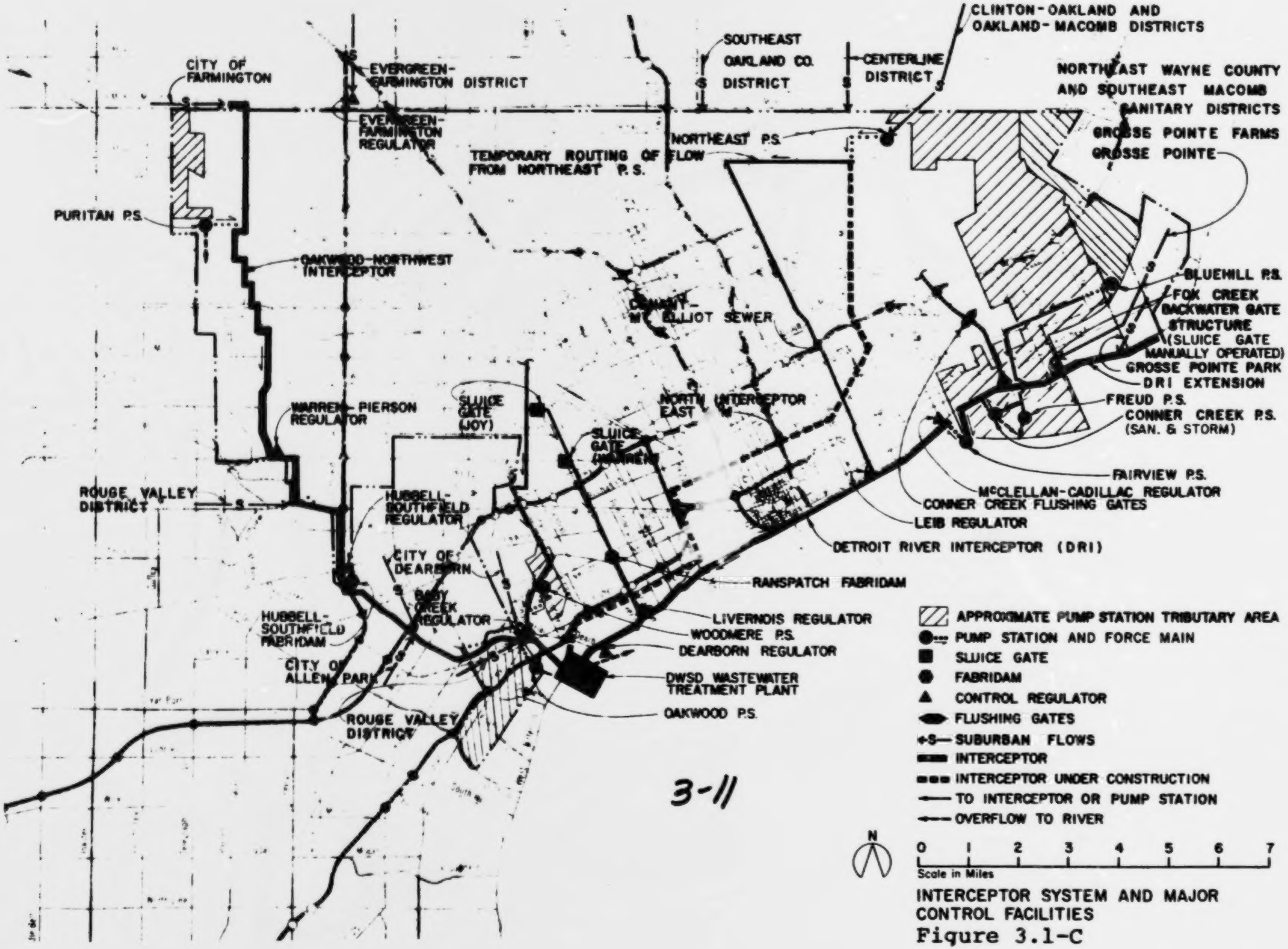
The DWSD assumed responsibility for operation and maintenance of the City of Detroit collection system, including seventeen system pumping stations from the Detroit Department of Public Works (DPW) in 1966. None of the seventeen pumping stations are manned on a continuous basis. Eight minor stations are automatic, with local controls, and the nine major stations are monitored with remote supervisory control from the System Control Center. Figure 3.1-C and Table 3.1-C give names and location of nine major pumping stations.

An evaluation of each of the nine pumping stations was performed by the facilities planning consultant. The evaluation found that in general the pumping stations are reliable but some do have problems. Some of the problems are: insufficient ventilation; accumulation of oil; the Systems Control Center operator is never certain if the storm pump is operating at the Conner Creek Station; the Oakwood Pumping Station does not have the capacity for a 10 year storm; and a general lack of preventive and rehabilitative maintenance in most stations.

### 3.1.1.3 Operation and Maintenance

Operation of the collection system is presently limited to the capabilities of the operator at the System Control Center Room to evaluate the impact of the storm event and make the necessary adjustments using remotely controlled equipment to minimize overflow of combined flows from the system. Most of the manpower is allocated to the maintenance rather than operation of the system.

In general, maintenance responsibility can be divided into three areas: the collection system conduits and interconnecting piping; the wastewater pumping stations; and the control and instrumentation equipment. There are basically six crews from various divisions within DWSD upon which upkeep of the collection system depends.


CLINTON-OAKLAND AND OAKLAND-MACOMB DISTRICTS
SOUTHEAST OAKLAND CO. DISTRICT
CENTERLINE DISTRICT
CITY OF FARMINGTON
EVERGREEN-FARMINGTON DISTRICT
EVERGREEN-FARMINGTON REGULATOR
NORTHEAST WAYNE COUNTY AND SOUTHEAST MACOMB SANITARY DISTRICTS
GROSSE POINTE FARMS
GROSSE POINTE
NORTHEAST P.S.
TEMPORARY ROUTING OF FLOW FROM NORTHEAST P.S.
PURITAN P.S.
OAKWOOD-NORTHWEST INTERCEPTOR
CONANT-MT. ELLIOT SEWER
BLUEHILL P.S.
FOX CREEK BACKWATER GATE STRUCTURE (SLUICE GATE MANUALLY OPERATED)
GROSSE POINTE PARK
DRI EXTENSION
FREUD P.S.
CONNER CREEK P.S. (SAN. & STORM)
WARREN-PIERSON REGULATOR
SLUICE GATE (JOY)
NORTH INTERCEPTOR EAST
SLUICE GATE (WARREN)
FAIRVIEW P.S.
McCLELLAN-CADILLAC REGULATOR
CONNER CREEK FLUSHING GATES
LEIB REGULATOR
DETROIT RIVER INTERCEPTOR (DRI)
ROUGE VALLEY DISTRICT
HUBBELL-SOUTHFIELD REGULATOR
CITY OF DEARBORN
RANSPATCH FABRIDAM
BABY CREEK REGULATOR
LIVERNOIS REGULATOR
HUBBELL-SOUTHFIELD FABRIDAM
WOODMERE P.S.
DEARBORN REGULATOR
CITY OF ALLEN PARK
DWSD WASTEWATER TREATMENT PLANT
ROUGE VALLEY DISTRICT
OAKWOOD P.S.
S
▨ APPROXIMATE PUMP STATION TRIBUTARY AREA
●--- PUMP STATION AND FORCE MAIN
■ SLUICE GATE
● FABRIDAM
▲ CONTROL REGULATOR
⬣ FLUSHING GATES
+S— SUBURBAN FLOWS
▬ INTERCEPTOR
▬ ▬ ▬ INTERCEPTOR UNDER CONSTRUCTION
← TO INTERCEPTOR OR PUMP STATION
←-- OVERFLOW TO RIVER
N
0 1 2 3 4 5 6 7
Scale in Miles

INTERCEPTOR SYSTEM AND MAJOR CONTROL FACILITIES
Figure 3.1-C

3-12

Table 3.1-C

Major Detroit Pumping Stations

| Station Name | Location | Present Total Peak Capacity, cfs | Discharge Point |
|---|---|---|---|
| Northeast | On the south side of Eight Mile Road between Hoover Road and Van Dyke Avenue. | 400 (11 $m^3/s$) (sanitary) | Seven Mile Sewer |
| Freud | Approximately one-half mile southeast of Conner Creek station, close to the Detroit River. | 70 (2 $m^3/s$) (sanitary)<br>4,000 (113 $m^3/s$) (storm) | Jefferson Avenue Relief Sewer<br>Conner Creek open channel |
| Conner Creek | East Jefferson and Connor Creek | 325 (9 $m^3/s$) (sanitary)<br>4,000 (113 $m^3/s$) (storm) | Detroit River Interceptor<br>Conner Creek open channel |
| Woodmere | Approximately two miles north of the DWSD treatment plant at the upstream end of Baby Creek Enclosure. | 16 (0.5 $m^3/s$) (sanitary)<br>768 (22 $m^3/s$) (storm) | Baby Creek Enclosure |
| Fairview | Approximately one mile southwest of Conner Creek station, close to the Detroit River. | 525 (15 $m^3/s$) (sanitary) | Detroit River Interceptor |
| Puritan | In a residential area west of the Rouge River and south of Six Mile Road. | 24 (0.7 $m^3/s$) (sanitary) | Inverted siphon to the Northwest Interceptor |
| Oakwood | Approximately one-half mile west of the DWWTP. | 40 (1 $m^3/s$) (sanitary)<br>488 (14 $m^3/s$) (storm) | Northwest Interceptor<br>O'Brien Drain |
| Bluehill | In the Fox District | 20 (0.6 $m^3/s$) (sanitary)<br>1,170 (33 $m^3/s$) (storm) | Mack Avenue and Fox<br>Creek Relief Sewers |
| Clintondale | Fifteen Mile Road near Lake St. Clair | 120 (3 $m^3/s$) (sanitary) | Fifteen Mile Road Interceptor |

The maintenance of all pumping stations, instrumentation, flow regulating, and diversion equipment is handled by the Central Maintenance Division. Crews dispatched from Central Maintenance generally attend to problems identified by the System Computer Control Room. Little in the way of an overall program of preventive maintenance has been implemented in the DWSD system. Most maintenance is of the emergency response type.

With limited manpower being a major problem, priorities are established by the System Control Center, and lower priority items, such as overflow sensors, and rain gages, may remain in disrepair for several months.

To assure that the equipment is operating properly and will perform reliably, a preventive maintenance program needs to be established. Should the present techniques of maintenance continue, it is reasonable to assume that additional manpower will be required for increased emergency repairs as the equipment continues to deteriorate.

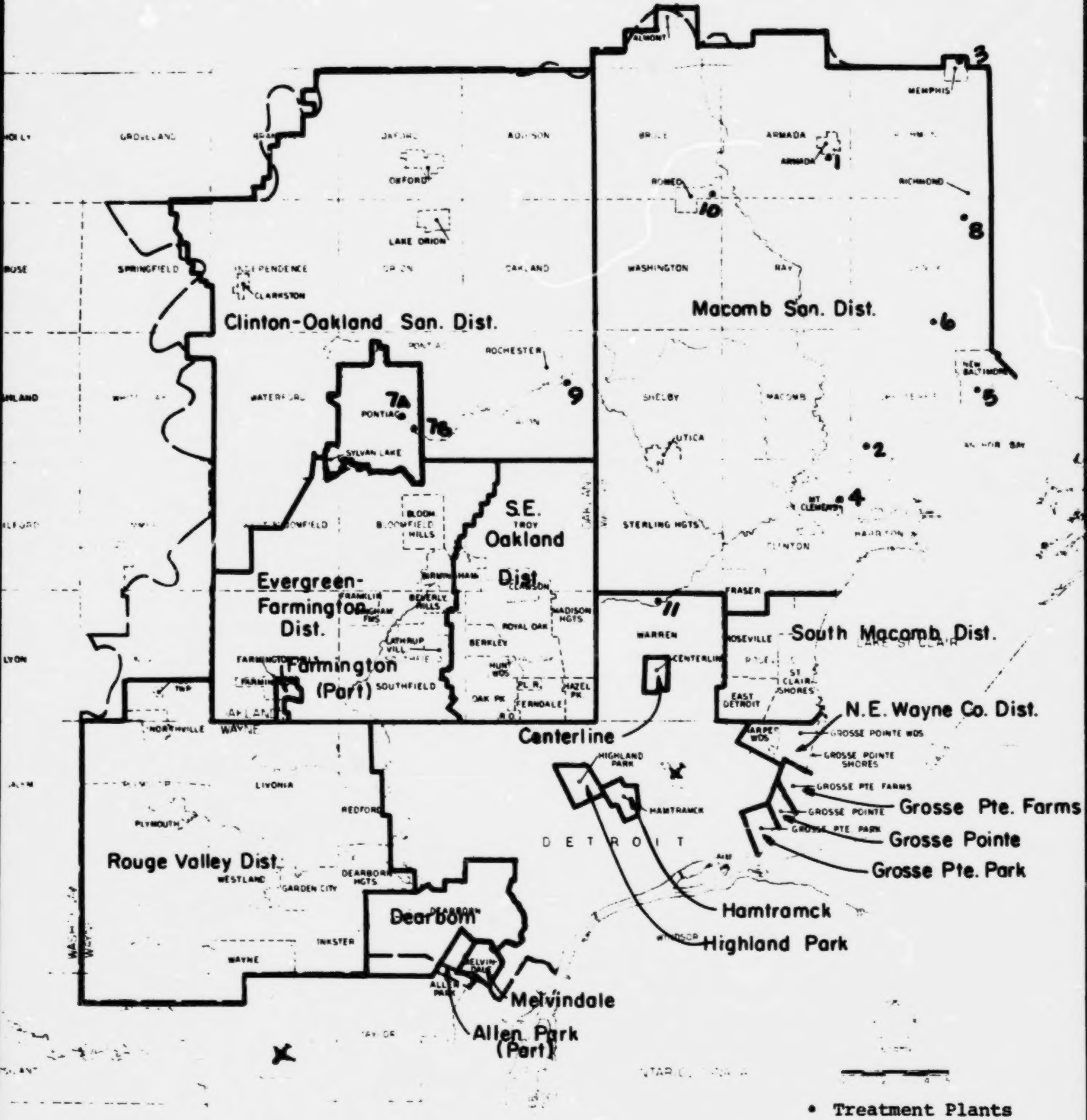
### 3.1.2 Suburban Wastewater Collection Systems

The DWSD serves large metropolitan suburban areas in Wayne, Oakland, and Macomb Counties with water supply and wastewater disposal. Outside the City of Detroit, the wastewater disposal system: serves a population of over 2,000,000 in mostly residential suburban communities; receives wastewater from some 150 significant industrial discharges; includes approximately 75,000 acres (30,352 ha) served by combined sewers; and contains over 70 combined sewer overflow points in the older established communities.

All wastewater transport and treatment services for suburbs are provided by the DWSD via contractual agreements. Suburban communities and authorities are billed by the DWSD for this service. The Detroit City Council approves the rates set by the DWSD Board of Commissioners. The majority of civil divisions in the area are provided service through operating agencies such as Drain Commissioners, DPW, etc. Three out of seven commissioners on the DWSD Board are representatives of the suburban areas.

There are seven districts that provide wastewater disposal service to multiple communities (Figure 3.1-D). These communities have contract agreements with the districts. The districts, in turn, have agreements with the DWSD for wastewater disposal. The area, population, maximum allowable flow, etc., are given in Appendix 11.6 for each sanitary district.

There are ten communities that have a contract agreement directly with the Detroit Water and Sewerage Department for wastewater disposal. These ten communities are summarized in Appendix 11.5 and shown in Figure 3.1-D.


Clinton-Oakland San. Dist.
Macomb San. Dist.
S.E. Oakland Dist.
Evergreen-Farmington Dist.
Farmington (Part)
South Macomb Dist.
N.E. Wayne Co. Dist.
Centerline
Grosse Pte. Farms
Grosse Pointe
Grosse Pte. Park
Hamtramck
Highland Park
Rouge Valley Dist.
Dearborn
Melvindale
Allen Park (Part)
DETROIT
1
2
3
4
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7A
7B
8
9
10
11
ALMONT
MEMPHIS
ARMADA
ROMEO
RICHMOND
OXFORD
LAKE ORION
CLARKSTON
SPRINGFIELD
INDEPENDENCE
WASHINGTON
ROCHESTER
WATERFORD
PONTIAC
SYLVAN LAKE
NEW BALTIMORE
SHELBY
UTICA
MT. CLEMENS
STERLING HGTS
CLINTON
FRASER
WARREN
ROSEVILLE
ST. CLAIR SHORES
EAST DETROIT
BLOOMFIELD HILLS
TROY
BIRMINGHAM
BEVERLY HILLS
FRANKLIN
CLAWSON
ROYAL OAK
MADISON HGTS
BERKLEY
LATHRUP VILL
SOUTHFIELD
HUNTINGTON WDS
OAK PK
PLEASANT RIDGE
FERNDALE
HAZEL PK
FARMINGTON
NORTHVILLE
WAYNE
LIVONIA
REDFORD
PLYMOUTH
WESTLAND
GARDEN CITY
DEARBORN HGTS
INKSTER
HARPER WDS
GROSSE POINTE WDS
GROSSE POINTE SHORES
GROSSE PTE FARMS
GROSSE POINTE
GROSSE PTE PARK
HIGHLAND PARK
HAMTRAMCK
WINDSOR
MELVINDALE
ALLEN PARK

• Treatment Plants

SUBURBAN WASTEWATER DISTRICTS AND TREATMENT PLANTS
Figure 3.1-D

Key to suburban plants identified by numbers is presented in Appendix 11.5

There are eleven suburban communities which do not have contracts with the DWSD. A summary of the location, type of treatment, capacity, etc. of the wastewater facilities serving these communities is presented in Appendices 11.6 and 11.7. Figure 3.1-D shows the approximate location of each treatment facility.

### 3.1.2.1 Suburban Interceptor Systems

There are five interceptor systems which convey wastewater from all the tributary suburban areas to the Detroit system. These five interceptor systems are the Rouge Valley, Evergreen-Farmington, Southeast Oakland County, Clinton-Oakland Macomb, and the Grosse Point-Jefferson systems.

The Rouge Valley System transfers flow from both combined and separate systems. The Wayne County Department of Public Works (WCDPW), the operating agency for the Rouge Valley District, entered into an agreement that allows the District to dispose of its wastewater flows into the DWSD system. The maximum discharge capacities are limited by contract to 230 cfs (7 $m^3/s$) into the Oakwood Interceptor and 94.5 cfs (2.7 $m^3/s$) into the Northwest Interceptor. In addition, the agreement does not allow separate storm drain connections to the DWSD system, except for combined sewer areas already served by the Rouge Valley Interceptor, with major branches along the Lower and Middle Rouge Valleys. There are at least 40 overflows along the Lower and Middle Interceptors which allow excess combined sewage to bypass to the watercourses during wet weather.

The Evergreen-Farmington System transfers combined and separate flows to the Detroit Southfield Sewer. The operating agency for the Evergreen-Farmington Sanitary District (EFSD) is the Oakland County Department of Public Works (OCDPW). There is a current agreement with the DWSD to discharge up to 75 cfs (2 $m^3/s$) into Detroit's system from the EFSD. By contractual agreement, the EFSD must control the flow into Detroit's system such that the flow limits are not exceeded. Excess flow can be diverted if the Detroit outlet sewer is flowing full. Thus, during wet weather combined sewage is diverted to the River Rouge.

The Southeast Oakland County System consists of both combined and separate sewers. The entire Southeast Oakland County Sanitary District (SEOCSD) discharges through the Dequindre Interceptor to the Detroit East Seven Mile Road Relief sewer. The Oakland County Drain Commissioner's (OCDC) office,(the operating agency for SEOCSD), has a contractual agreement with the DWSD to treat the wastewater from the district. Current maximum allowable discharge into the Dequindre Interceptor is about 278 cfs (8 $m^3/s$). The county is obligated to regulate and measure sanitary flow and may be required to cease discharging entirely when Detroit's Seven Mile Relief Sewer is flowing full.

The Clinton-Oakland Macomb System serves the Clinton-Oakland Sanitary District and the Macomb Sanitary District. The DWSD has service contracts with the Oakland County Department of Public Works and the Macomb County Public Works Commissioner which are the operating agencies. The interceptor system is made up of eight major interceptors. The system is to flow into the East Arm of the North Interceptor, presently under construction.

The Grosse Point-Jefferson System serves the South Macomb and the Northeast Wayne County Sanitary Districts. The Wayne County Road Commission is the operating agency for the Northeast Wayne County Sanitary District which has an agreement with the DWSD to discharge up to a maximum of 127 cfs (4 $m^3/s$) into the DWSD sewer system. The South Macomb Sanitary District has a contract with the Wayne County Road Commission for sanitary sewage disposal service. A system of combined and separate sewers serves all the communities in both sanitary districts. The Jefferson Interceptor carries wastewater from the South Macomb Sanitary District to the Wayne County and Grosse Point Interceptor (WCGPI). From this point, flow is transported via the WCGPI through the Fox Creek Enclosure and then to the Detroit River Interceptor.

### 3.1.2.2 Suburban Combined Sewer Overflows

Combined sewer overflows from suburban areas are summarized in Appendix 11.8. Most of the outfalls are located along the River Rouge and Lake St. Clair.

The MDNR has identified the Milk River Pumping Station, located in the Northeast Wayne County Sanitary District, as a point source of pollution and must incorporate corrective measures to come within acceptable discharge limitations.

In the South Macomb Sanitary District, it has been found that the Chapaton and Martin Retention Basins overflow to Lake St. Clair on an average of 11.3 and 12.4 times per year, respectively (Giffels/Black and Veatch, 1977, Book XI).

Problems of overflowing to streets and flooding basements have been noted in the Southeast Oakland County Sanitary District and several of the individual suburban communities.

The major portion of the overflows to the River Rouge come from the Rouge Valley Sewage Disposal District (approximately 40 outfalls) and the City of Dearborn (about 22 outfalls).

## 3.2 Wastewater Flows

The 1976 total dry weather flow to the DWWTP is 544 mgd (2,184,000 $m^3/d$). This flow is based on the domestic, commercial, industrial, and infiltration/inflow components from both the city drainage districts and the suburban sewerage districts previously discussed, plus 11 mgd (42,000 $m^3/d$) estimated dry weather overflow and 45 mgd (170,000 $m^3/d$) of steady extraneous flow (unaccounted for water reaching the combined sewers).

Dry weather flow rates are necessary as the base for computation of sanitary and industrial discharges, treatment requirements, and interceptor design. These flows have been computed for the City of Detroit, including Hamtramck and Highland Park, and for the suburban areas. Because, for wholesale purposes, there are meters on many of the suburban discharges to the DWSD sewers, a more reliable estimate of per capita flows can be developed for these areas than for the City of Detroit. No direct wastewater flow measurements are made routinely in Detroit except at the treatment plant where estimates of total daily flow pumped, based on pump-on time, are kept. Pump rating curves are suspect and an adjustment has been made; in addition, there is significant unmetered recycle flow. Thus, data for total pumped flows at the treatment plant can only be considered to be accurate within ± 10 percent.

### 3.2.1 City of Detroit

When the population of a city has not stabilized and is on the increase, there is a general trend toward gradual increase in per capita water use. This increase reflects changes in water use habits, such as purchase of dishwashers, garbage disposals, etc. In cities where the population has stabilized or is decreasing, the per capita consumption tends to remain steady. Wastewater per capita flows follow water use trends. Indications are that the population will decrease in the City of Detroit, which suggests that the average domestic per capita flow rate will remain constant in the future.

Average domestic dry weather per capita flows were estimated in the western districts of Detroit (using level gages) and at the Bluehill Pumping Station (eastern Detroit) by excluding the suburban flows, the reported average industrial flows, and estimated commercial flows from these in-city flows. The commercial wastewater component was estimated by assuming 100 percent of the water used by commercial accounts was returned to the sewers.

In the OP/EA, 70 gcd (0.26 $m^3/c.d$) was determined as the base domestic flow for all districts in the City of Detroit (including Hamtramck and Highland Park), except Baby

Creek, where a flow of 90 gcd (0.34 $m^3$/c.d) was used. The existing dry weather flows are presented in Table 3.2-A for each drainage district. The present dry weather wastewater flow is 294 mgd (1,113,000 $m^3$/d) for a population of 1,538,443.

### 3.2.2 Suburban

Records of metered flow from suburban cities and districts were analyzed to arrive at average dry weather flows. From these flows the present significant industrial flows were subtracted. The result was then an estimate of domestic and commercial flow plus infiltration. This value was divided by the connected population to give an estimate of present per capita flow (less industrial).

In general, this computation gave reasonable per capita flows. Exceptions were the results from Clinton-Oakland and Macomb Sanitary Districts and from the City of Allen Park. Values for the Oakland and Macomb County districts were recomputed using 1976 data instead of the average of 1970 through 1975 data. A figure of 130 gcd (0.49 $m^3$/c.d) was obtained and this value was adopted as being more consistent with other suburban results.

If the metered records for Allen Park are correct, there is an excessive amount of infiltration. Although the tributary population is small and the per capita flow adopted will not change flows significantly, it was assumed that a program of remedial work on the sewerage system will reduce per capita flows to a contribution similar to adjacent Dearborn.

The suburban average dry weather flows are presented in Table 3.2-B for both multiple-districts and independent districts. The present suburban average dry weather flow is 226.7 mgd (858,100 $m^3$/d). This flow includes the commercial and industrial flows from the nine drainage districts within the city (Table 3.2-A) and the significant industrial dischargers' flow from the suburban districts (Table 3.2-B).

### 3.2.3 Wet Weather Flows

There have not been any direct measurements of wet weather flows. Therefore, combined sewer overflows were estimated by the facilities planning consultant using existing U.S. Weather Bureau rainfall data for Detroit, deducting storage, and converting this to rainfall excess. Then a simplified model of the combined sewer system was utilized to divide the rainfall excess into flow to the treatment plant and overflow to the rivers. This calculation provides estimates of average annual flows.

The results of the calculations represent average flows and are useful for computing phosphorus loadings to Lake Erie, etc. Peak flows are considerably higher.

TABLE 3.2-A

## PRESENT DETROIT DRY WEATHER WASTEWATER FLOWS

| District | Population | Domestic, Commercial and Industrial mgd* | Infiltration Inflow mgd* | Total mgd* |
|---|---|---|---|---|
| Rouge River Subtotal | 124,780 | 13.4 | 10.0 | 23.4 |
| Southfield Subtotal | 111,732 | 10.5 | 1.7 | 12.2 |
| Hubbell Subtotal | 95,068 | 11.2 | 1.4 | 12.6 |
| Baby Creek Subtotal | 282,992 | 45.8 | 4.2 | 50.0 |
| Oakwood | 16,775 | 3.4 | 0.3 | 3.7 |
| Fox Creek Subtotal | 131,456 | 13.6 | 2.0 | 15.6 |
| Conner Creek Subtotal | 254,213 | 46.0 | 3.8 | 49.8 |
| East Jefferson | 61,524 | 5.8 | 4.4 | 10.2 |
| Central Subtotal | 459,903 | 73.6 | 42.4 | 116.0 |
| TOTAL | 1,538,443 | 223.3 | 70.2 | 293.5 |

* 1.0 mgd = 3785.0 $m^3/d$

## Table 3.2-B

## Suburban Average Dry Weather Flows by District

| Suburban Sewer Districts<br>Multiple-Districts | Connected Pop.**** | Avg. Metered DWSD Billing (mgd)# | Significant Ind. Discharge Flow (mgd)# | Avg. Flow, Less Industry (mgd)# | Per Capita Flows (gcd)## | Use For Future Per Capita Flows (gcd)## |
|---|---|---|---|---|---|---|
| Southeast-Oakland | 348,600 | 58.4 | 5.0 | 53.4 | 153 | 153 |
| Northeast Wayne County | 45,700 | 5.5 | 0 | 5.5 | 120 | 120 |
| South Macomb County | 200,000 | 24.2 | 0.1 | 24.1 | 121 | 121 |
| Rouge Valley | 500,450 | 60.7 | 5.0 | 55.7 | 111 | 111 |
| Evergreen-Farmington | 204,000 | 23.2 | 2.0 | 21.2 | 104 | 104 |
| Macomb County | 173,700 | 16.0 | 2.0 | 14.0 | 81 | 130** |
| Clinton-Oakland | 84,600 | 3.5 | 0 | 3.5 | 41 | 130** |
| **Independent Districts** | | | | | | |
| Allen Park | 3,800 | 1.7 | 0.1 | 1.6 | 421*** | 116*** |
| Centerline | 10,600 | 1.3 | 0.2 | 1.1 | 104 | 104 |
| Dearborn | 104,000 | 23.1 | 11.0 | 12.1 | 116 | 116 |
| Farmington (Part) | 10,100 | 1.6 | 0 | 1.6 | 158 | 158 |
| Grosse Pointe** | 6,660 | 0.9* | 0 | 0.9 | 136 | 136 |
| Grosse Pointe Farms** | 12,600 | 1.8* | 0 | 1.8 | 143 | 143 |
| Grosse Pointe Park | 15,400 | 2.8 | 0 | 2.8 | 182 | 182 |
| Melvindale | 13,500 | 2.0* | 0.2 | 1.8 | 133 | 133 |
| TOTAL | 1,733,650 | 226.7 | 25.6 | 201.1 | 116 | - |

* Not metered; based on water use.

** Based on 1975 metered flows.

# Metric Conversion - mgd x 3785 = $m^3/d$

*** Apparently excessive infiltration; use Dearborn values.

**** 1976 DWSD estimates.

## Metric Conversion - gcd x 0.003785 = $m^3/c{\cdot}d$

Initial calculations of overflow are based on the division of the City of Detroit combined sewer system into two separate systems. These are the East and the West systems and can be described by the fact that the West system flow enters the DWWTP by the Oakwood-Northwest Interceptor and the East system flow enters the DWWTP by the DRI.

The total average daily wet weather flow in excess of dry weather flows has been estimated to be approximately 196 mgd (742,000 m$^3$/d). About 84 mgd (317,940 m$^3$/d) receives treatment; 52 mgd (196,820 m$^3$/d) contributed by the East system and 36 mgd (136,260 m$^3$/d) contributed by the West system. Annual overflows to the Detroit and Rouge Rivers average 112 mgd (423,920 m$^3$d).

It has also been estimated that the total 24 hour areal rainfall volume during a 10 year storm is 13,600 million gallons (51,476,000 m$^3$/d), compared to 1,100 mgd (4,164,000 m$^3$/d) treatment plant capacity.

The previous NPDES permit, MI0022802, defines wet weather flow conditions as existing when rainfall or snow melt exceeds an average of 0.01" over the service area. The permit also states that the discharge limitations set for normal weather flow conditions, shall not apply during periods of wet weather flow conditions.

### 3.2.4 Infiltration/Inflow

#### 3.2.4.1 City of Detroit

The average domestic dry weather per capita flows determined for the Hubbell, Southfield, and Baby Creek Districts, and for the Fox Creek Subdistrict 4 (tributary to Bluehill Pumping Station) compare reasonably well with water use, suggesting these areas have limited infiltration. This is due to the clay soil which underlies Detroit east of the Rouge Valley. However, since no sewer system is completely free from leakage, a value of 15 gcd (0.06 m$^3$/c.d) infiltration has been assumed for all districts except the River Rouge District. In the sandy soils of the River Rouge District, a value of 80 gcd (0.3 m$^3$/c.d) infiltration has been assumed. Table 3.2-A also includes the infiltration/inflow for all nine drainage districts. The per capita infiltration/inflow for the East Jefferson (72 gcd; 0.27 m$^3$/c.d.) and Central (92 gcd; 0.35 m$^3$/c.d) Drainage Districts are considerably higher than the other districts. This is due to the river inflow during periods when the Detroit River levels are high. The average annual river inflow rate applicable has been estimated at 85 mgd (321,725 m$^3$/d). Table 3.2-C shows the distribution of the inflow, based upon a survey performed in 1976.

## Table 3.2-C

## SOURCES OF RIVER INFLOW

| Subdistricts | Sources Found In 1976 | Allocated River Inflow (mgd) |
|---|---|---|
| East Jefferson 1 | 1 | 7.7 |
| Central 8 | Minor | 0 |
| Central 7 | 1 | 7.7 |
| Central 6 | 3 | 23.2 |
| Central 5 | 3 | 23.2 |
| Central 4 | 0 | 0 |
| Central 3 | 2 | 15.5 |
| Central 2 | 1 | 7.7 |
| Central 1 | 0 | 0 |
| Baby Creek 1 | Minor | 0 |
| | | 85.0 |

#### 3.2.4.1 Suburban

A general assessment of the I/I in the suburbs has categorized each district as "poor", "not good", or "acceptable". These categories relate to the ratio of dry weather flows to water sales. Three of the largest multiple sewer districts are in the "poor" category; it includes Southeast Oakland, Northeast Wayne-South Macomb, and Rouge Valley. All of these districts are experiencing infiltration and/or inflow in excess of acceptable limits. Since these three districts represent over 62 percent (62%) of the total present suburban population, a considerable amount of additional flow above acceptable limits has resulted. The problem will increase as the population increases and as aging of the existing sewers continue. The other communities in the "poor" category -- Grosse Point Farms, Centerline, Melvindale, and Highland Park -- also have I/I problems. The impact of these communities on the DWSD system would not be as great compared to the whole of the suburbs; however, there are problems associated with large storm flows in these areas where existing imterceptors cannot handle the storm plus sanitary flow.

The communities of Allen Park, Farmington, Grosse Point, and Grosse Point Park are in the "not good" category. As mentioned previously, they may have serious problems which should be given immediate consideration. The total population of these four communities, however, is only 2 percent (2%) of the total population of the suburbs at this time. So, although the internal problems are serious, they are not a significant factor of the total suburban contribution or the total flow contribution to DWSD treatment facilities.

All the other districts were classified in the "acceptable" category and do not appear to have I/I problems of a significant nature. A substantial increase in population in the Macomb Sanitary District and the Clinton-Oakland District may increase the total amount of I/I to DWSD in the future. However, this increase is expected and as long as the future collections systems which contribute to the DWSD system are constructed as completely separate systems, with particular attention given to prevention of infiltration, then the flows should remain within acceptable limits.

### 3.3 Wastewater Treatment Facilities

The DWWTP is located near the confluence of the Rouge and Detroit Rivers in the DelRay area of Detroit. It is owned and operated by the DWSD. The Detroit River is the receiving water for the plant's effluent, with an overflow to the River Rouge. In the past, the DWSD has followed a policy of regionalization at a central wastewater treatment plant. The vast majority of the region's wastes are treated at this plant. However, for economic or political reasons, some communities have chosen to construct their own treatment facilities independent of the DWSD.

The DWWTP was completed in 1940 to serve Detroit and several of the nearby suburbs. At that time, the plant provided primary treatment and disinfection, with discharge to the Detroit River through the current outfall. Various additions to the plant were constructed from 1954 to 1966. Operation of sewers was assigned to the DWSD in 1965, and a comprehensive regional watershed pollution control program was launched.

In 1969, after a pilot study, DWSD selected the activated sludge process for expansion of the plant to secondary treatment. Additional land was acquired and, with Federal and State funds, a phased construction program was begun; this program is still under way. Table 3.3-A presents a list of those facilities which are under construction, or under contract for construction, and Table 3.3-B shows contracts which are currently scheduled but not awarded for construction. Those contracts (both awarded and not awarded for construction) presented in Tables 3.3-A and 3.3-B are considered as part of the existing facilities for the EIS.

### 3.3.1 Raw Wastewater Characteristics

The DWSD historical records of raw wastewater characteristics are subject to considerable error. Raw sludge and side streams of the treatment process are often "recycled" to the interceptors. Sampling devices at the head of the plant may record the same pollutant several times and provide an erroneously high reading of the true wastewater strength. Raw wastewater characteristics of the DRI and the Oakland Interceptor are sampled to preclude errors.

The facilities planning consultant became aware of these sampling problems, and made an effort to correct for the errors. Table 3.3-C represents the best estimate of the true raw wastewater characteristics, without the effects of "recycle" streams, and is representative of the actual loadings the plant must treat in dry weather.

### 3.3.2 Existing Unit Processes

The DWWTP is designed to use the activated sludge process to provide secondary treatment, with phosphorus removal using ferrous chloride to precipitate phosphorus in the primary and secondary clarifiers. Sludge processing includes vacuum filtration of raw sludge followed by incineration. Figure 3.3-A shows the flow diagram for the treatment process. Not all of the designed elements are on-line.

## Table 3.3-A

## Facilities Under Construction Or Under Contract for Construction

| Contract Number | Description | Expected Completion |
|---|---|---|
| PC-283 | Aeration Tanks No. 3 and 4 and Intermediate Lift Pumping Stations | Fall, 1977 |
| PC-284 | Four Final Tanks | Summer, 1977 |
| PC-288A | Oxygen Plant (380 ton/day) | Fall, 1979 |
| PC-294 | Six Sludge Thickeners | Fall, 1978 |
| PC-299 | Sedimentation Tank Flow Control Improvements | Summer, 1977 |
| PC-400 | Sludge Complex I Improvements | Summer, 1980 |
| PC-406A | Four Final Clarifiers | Summer, 1978 |
| PC-408 | Four Final Clarifiers | Spring, 1979 |
| PC-407 | Four Primary Tanks Renovation - Group 1 | Fall, 1978 |

## Table 3.3-B

## Contracts Which Are Currently Scheduled But Not Awarded For Construction

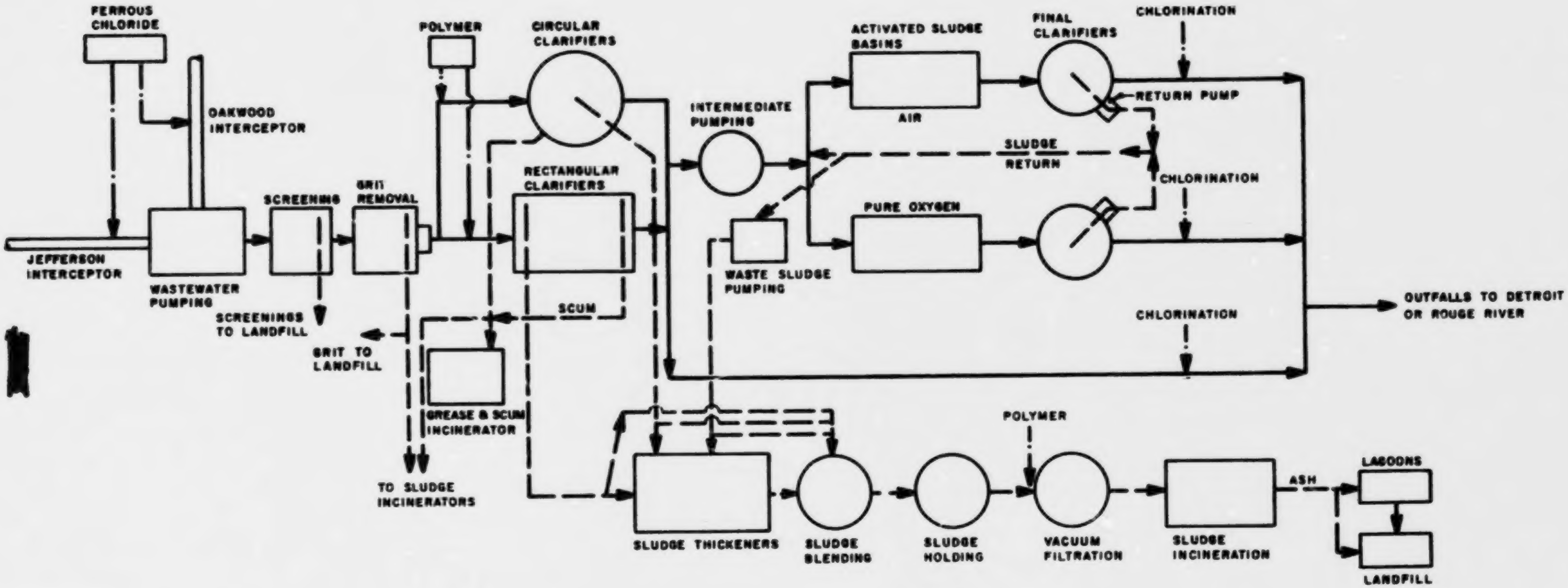
| Contract Number | Description | Expected Completion |
|---|---|---|
| PC-276 | Primary Tanks A3 and A4 | Spring, 1979 |
| PC-295 | Sludge Complex III | Spring, 1980 |
| PC-413 | Instrument Service Contract (Emergency and preventive maintenance service and operator training) | Fall, 1977 |
| CS-01 | Operation and Maintenance Manuals | Not known |
| CS-801 | Site Improvements (Drainage, etc.) | Not known |
| CS-802 | Tall Stacks for Incinerator Complexes I and II | Not known |
| CS-804 | Employees Service Building | Not known |
| CS-805 | Electrical System Renovation | Not known |
| -- | Computer Maintenance Contract | Not known |
| CS-813 | Interim Sludge Disposal Contract (415 dry tons/day) | December, 1979 |
| -- | Primary Tanks Renovations - Groups II and III | Not known |
| CS-816 | Grit Removal System Improvements | Not known |

## Table 3.3-C

## Raw Wastewater Characteristics

| Constituents | Average* Concentration | Observed Range |
|---|---|---|
| $BOD_5$ | 103 mg/l | 28-252 |
| Total Suspended Solids | 218 mg/l | 75-1,430 |
| Volatile Suspended Solids | 135 mg/l | 19-670 |
| Grease | 49 mg/l | 3.7-154 |
| Phenols | 234 µg/l | 15-3,093 |
| Phosphorus | 4.9 mg/l | 1.2-14.0 |
| Chemical Oxygen Demand | 494 mg/l | 3-9,000 |
| Chloride | 159 mg/l | 45-1,653 |
| Iron | 9.1 mg/l | 0.2-125 |
| Copper | 0.30 mg/l | Trace - 2.78 |
| Cyanide | 0.12 mg/l | Trace - 1.84 |
| Total Chromium | 0.39 mg/l | 0.03-2.22 |
| Zinc | 0.87 mg/l | 0.02-48.4 |
| Cadmium | 0.018 mg/l | Trace - 0.40 |
| Nickel | 0.47 mg/l | 0.10-5.80 |

*Weighted Average: 60% DRI, 40% Oakwood Interceptor.


FERROUS CHLORIDE
OAKWOOD INTERCEPTOR
JEFFERSON INTERCEPTOR
WASTEWATER PUMPING
SCREENING
GRIT REMOVAL
SCREENINGS TO LANDFILL
GRIT TO LANDFILL
POLYMER
CIRCULAR CLARIFIERS
RECTANGULAR CLARIFIERS
SCUM
GREASE & SCUM INCINERATOR
TO SLUDGE INCINERATORS
INTERMEDIATE PUMPING
WASTE SLUDGE PUMPING
ACTIVATED SLUDGE BASINS
AIR
SLUDGE RETURN
PURE OXYGEN
FINAL CLARIFIERS
RETURN PUMP
CHLORINATION
CHLORINATION
CHLORINATION
OUTFALLS TO DETROIT OR ROUGE RIVER
POLYMER
SLUDGE THICKENERS
SLUDGE BLENDING
SLUDGE HOLDING
VACUUM FILTRATION
SLUDGE INCINERATION
ASH
LAGOONS
LANDFILL

PROCESS SCHEMATIC OF DWWTP

Figure 3.3-A

Appendix 11.4 provides a summary of the unit processes for wastewater treatment, which explains their purpose, describes the available equipment, and discusses the performance of the equipment in achieving its treatment objectives. The SFP discusses the existing unit processes in much greater detail.

In general, the plant suffers from a large number of malfunctions and deficiencies in basic treatment units and auxiliary equipment. Consistent achievement of effluent limitations and air quality standards with the existing equipment would be very difficult under the best of circumstances. The physical problems, and the combination of the two makes achievement of standards nearly impossible.

### 3.3.3 Treatment Performance

In accordance with the requirements of PL 92-500, the DWWTP discharged its effluent to the Detroit River under an interim NPDES permit. On July 23, 1976, the MDNR revoked the city's permit due to its findings that the permit "has been, is being, and may be violated". The failure to comply with permit limitations was partially attributed to:

- continuing inadequacies in the availability and training of personnel for operating and maintaining the existing facilities; and

- continuing inadequacies in the maintenance programs and in the material procurement procedures .

The revocation was suspended on condition that the City comply with schedules to complete the required facilities plan, add new treatment units, perform rehabilitation work, submit a plan to reduce phosphorus levels, evaluate interim sludge disposal techniques, determine proper staffing levels, prepare and implement a training program, and prepare an Operation and Maintenance Manual. The U.S. EPA, the MDNR, and the City of Detroit agreed to the schedule contained in the Consent Judgment (Appendix 11.9).

Future and present effluent limitations have been set forth by the Consent Judgment, Appendix 11.9. These are also shown in Table 3.3-D. The following section examines how the observed performance of the plant compares to these standards.

Primary effluent $BOD_5$ from the rectangular and circular primaries averaged 75 mg/l. Data for a ten-month period of 1976 showed that average $BOD_5$ in the combined effluent of the air and oxygen activated sludge systems averages 20 mg/l and was below 30 mg/l, 84 percent (84%) of the time. Both systems performed comparably in removing $BOD_5$, but design loads are different. The 7 day limit of 130 mg/l was not exceeded by either system.

Table 3.3-D

Present and Expected
Future Effluent Limitations
for the DWWTP

Beginning on the effective date of the Consent Judgment and lasting until June 30, 1978.

| Effluent Characteristic | Discharge Load Limitations lb/day | | Discharge Concentration Limitations mg/l | |
|---|---|---|---|---|
| | 30-Day Avg. | 7-Day Avg. | 30-Day Avg. | 7-Day Avg. |
| $BOD_5$ | 650,000 | 975,000 | 87 | 130 |
| Total Suspended Solids | 1,200,000 | 1,800,000 | 160 | 240 |
| Phenol | 1,900 | 2,300 | 0.25 | 0.3 |
| Oil and Grease | - | - | - | 45 |
| Total Phosphorus (as P) | - | - | 4.0 | - |
| Fecal Coliform (MPN) | - | - | 200/100 ml | 400/100 ml |

pH 6.5 - 9.0 SU

Beginning on December 31, 1981 and lasting until the expiration date.

| Effluent Characteristic | 30-Day Avg. | 7-Day Avg. | 30-Day Avg. | 7-Day Avg. |
|---|---|---|---|---|
| $BOD_5$ | 263,000 | 394,000 | 30** | 45 |
| Total Suspended Solids | 263,000 | 394,000 | 30** | 45 |
| Phenol | 900 | 1,800 | 0.1 | 0.2 |
| Oil and Grease | - | - | - | 15 |
| Total Phosphorus (as P) | - | - | 1.0 | - |
| Fecal Coliform (MPN) | | | | |

pH 6.5 - 9.0 SU

** The monthly average removal efficiency shall not be less than 85%. The limitations herein are premised on the following projected maximum daily flows averaged over a 30 day period.

| | |
|---|---|
| From present to June 30, 1978 | 900 mgd |
| From December 31, 1979 to December 30, 1981 | 1,000 mgd |

For a more complete effluent limitation schedule, refer to the Consent Judgment (Appendix 11.8).

The higher effluent $BOD_5$ values were related to loss of suspended solids due to problems with the secondary clarifiers. Although the secondary units appear capable of achieving $BOD_5$ limits, modifications and/or other measures are required to consistently achieve acceptable $BOD_5$ and suspended solids concentration in the effluent.

Primary effluent suspended solids averaged 143 mg/l, mostly because of lack of sludge disposal capacity which results in sludge recycle to the primary tanks. The combined secondary effluent averaged 65 mg/l suspended solids, and achieved 30 mg/l only 28 percent (28%) of the time. These removal levels are attributed to the poor performance of the secondary clarifiers.

Phenols in the combined secondary effluent averaged 64 mg/l. A level of 10 mg/l phenols was achieved only three percent (3%) of the time by the air activated sludge and one percent of the oxygen activated sludge system. This contrasts with the relatively high $BOD_5$ removals. Questions regarding the accuracy and appropriateness of the analytical practices have been raised (Giffels/Black and Veatch, 1977, Book VIII).

Because of deficiencies in scum removal equipment, the plant is not meeting effluent limits for oil and grease.

The 30 day geometric mean fecal coliform density for 1975-1976 ranged from 30 to 176 per 100 ml. The worst 7 day geometric mean for 1976 was 394 per 100 ml. These figures exclude periods of chlorinator malfunctions. The effective disinfection is explained by the relatively high residual chlorine level of 1.7 to 2.3 mg/l which can be found at the end of the outfall.

Phosphorus data available for 1975 and 1976 showed that the average influent phosphorus (including effects of sludge recirculation) was 4.9 mg/l. The blended primary and secondary effluent phosphorus was 3.6 mg/l, for a removal rate of only 27 percent (27%). Settling in the primary tanks is not very effective in removing phosphorus. Average removals were only 20 percent (20%), with a primary effluent level of 4.1 mg/l. The secondary treatment system has an effluent phosphorus level of 1.2 to 1.3 mg/l, for a cumulative removal of 73 to 76 percent.

The poor performance of the primary tanks in removing phosphorus is believed to result from several factors. On a stoichiometric basis, the estimated iron feed rates can only be expected to remove 2 mg/l of phosphorus; ineffective mixing may further limit removals. Since sludge is often "recycled", resolubilization of suspended phosphorus may also occur.

### 3.3.4 Operation and Maintenance

The DWWTP is experiencing severe operation and maintenance problems. Information developed in the SFP (Giffels/Black and Veatch, 1977, Book VIII) suggests that the poor performance of the plant may result as much from poor operation and maintenance as it does from lack of equipment capacity.

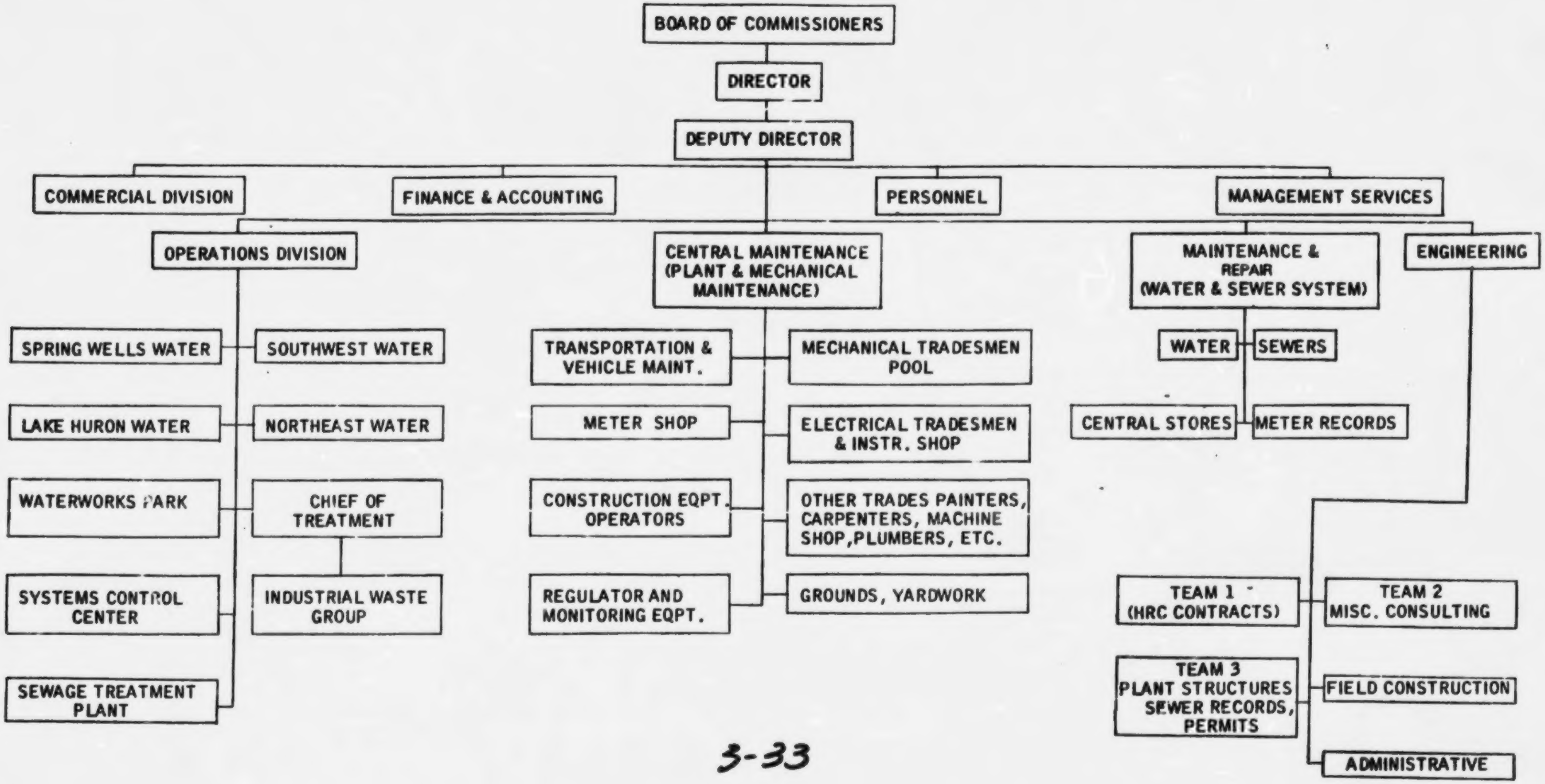
Thus, the operation and maintenance of the DWWTP is a critical issue to this environmental impact statement. Treatment facilities must be properly maintained and operated to achieve their design effluent limitations.

The technical details of the plant's operation and maintenance practices can be found in the SFP. The following sections briefly summarize these practices and discuss some of the problems.

Figure 3.3-B is an organization chart of the DWSD. The centralized management structure has eight functional groups. The sewage treatment plant falls under the operations division, along with five water supply units, the Systems Control Center and the Industrial Waste Group. Central maintenance services, construction, and engineering are responsibilities of other divisions which also serve water supply operations. Separate fiscal accounts are maintained for water and wastewater.

Current staffing at the wastewater treatment plant is a major problem area. Generally the deficiencies are of two types; lack of mid-level supervisors and the lack of highly skilled technicians complicated by too many unskilled workers (Giffels/Black and Veatch, 1977, Book VIII). Many specific problems have been identified which contribute to the overall staffing problem.

All positions are under the Detroit civil service system. The plant supervisor has authority to dismiss employees for cause, but has little control over replacement hiring which is handled by the Personnel Department. There is no formal permanent training system. The residency requirement of Detroit contributes to difficulties in hiring trained operators. The plant employees are unionized, and senior operators are in the same union as other labor categories. Therefore, under National Labor Relations Board rules, delegating supervisory and disciplinary responsibilities to the senior operators is not permitted. The combination of a high vacancy rate in supervisory positions and the inability of supervisors to delegate authority downward has overextended the supervisors spans of control to the point where proper management of staff is virtually impossible.


BOARD OF COMMISSIONERS
DIRECTOR
DEPUTY DIRECTOR
COMMERCIAL DIVISION
FINANCE & ACCOUNTING
PERSONNEL
MANAGEMENT SERVICES
OPERATIONS DIVISION
CENTRAL MAINTENANCE (PLANT & MECHANICAL MAINTENANCE)
MAINTENANCE & REPAIR (WATER & SEWER SYSTEM)
ENGINEERING
SPRING WELLS WATER
SOUTHWEST WATER
LAKE HURON WATER
NORTHEAST WATER
WATERWORKS PARK
CHIEF OF TREATMENT
SYSTEMS CONTROL CENTER
INDUSTRIAL WASTE GROUP
SEWAGE TREATMENT PLANT
TRANSPORTATION & VEHICLE MAINT.
MECHANICAL TRADESMEN POOL
METER SHOP
ELECTRICAL TRADESMEN & INSTR. SHOP
CONSTRUCTION EQPT. OPERATORS
OTHER TRADES PAINTERS, CARPENTERS, MACHINE SHOP, PLUMBERS, ETC.
REGULATOR AND MONITORING EQPT.
GROUNDS, YARDWORK
WATER
SEWERS
CENTRAL STORES
METER RECORDS
TEAM 1 (HRC CONTRACTS)
TEAM 2 MISC. CONSULTING
TEAM 3 PLANT STRUCTURES SEWER RECORDS, PERMITS
FIELD CONSTRUCTION
ADMINISTRATIVE

DWSD ORGANIZATIONAL STRUCTURE
FISCAL YEAR 1976-1977

Figure 3.3-B

Process control is hampered by lack of basic data and inherent design/construction inadequacies. The SFP (Giffels/Black and Veatch, 1977, Book VIII) has identified many instances of malfunctioning flow meters, weighing equipment, etc., that have made it impossible to accurately determine such important variables as wastewater flow and sludge quantities. Design/construction inadequacies, also addressed in the SFP include insufficient sludge recycle capacity and unstable secondary operation.

A computer system has been installed to assist in process control. However, the lack of basic control information, described above, negates the effectiveness of this system and reduces the computer to a monitoring function. Under these circumstances, the computer system generates a need for skilled maintenance personnel without producing commensurate benefits in process control.

The treatment plant is equipped with a laboratory capable of performing a wide variety of tests. This laboratory also serves the industrial waste group.

Overall, the DWWTP is in a very poor state of repair. The SFP documents some of the maintenance problems, which can be traced to several primary causes:

- there is no plan for preventative maintenance;
- personnel are inadequate in numbers, training, and supervision to implement an effective O&M program;
- inventories of replacement parts are almost completely depleted; and
- purchasing procedures are involved and time consuming, making it difficult to obtain replacement parts in a timely manner. Various changes have been instituted, but it is too early to assess the effectiveness. All purchases over $100 are handled by the city's Purchasing Department.

Plant construction is the responsibility of the engineering division of the DWSD. A number of the plant's deficiencies can be attributed to poor contract management. As documented by the SFP many units as installed, do not meet their design specifications. In the past, DWSD has accepted this equipment at reduced cost. For example, some return sludge pumps were accepted at reduced prices because wire to water efficiencies were less than specified. This practice, however, may not adequately account for the differential costs to bring the deficient equipment up to specifications.

## 3.4 Summary

This chapter describes the current collection and treatment facilities for wastewater in Detroit. An inventory of existing systems performance, maintenance, and inadequacies provides the basis upon which system alternatives are built.

## 4.0 FUTURE SITUATION

The population, land use, economic, and wastewater flow forecasts used in the study are presented in this section. The methods utilized to derive these forecasts are also evaluated. As discussed in Section 1.0, the nature of the "no action" alternative defined during the study process makes these forecasts the baseline conditions for alternative evaluation. Forecasts of air and water quality are included with an evaluation of the future situation regarding cultural resources and rare and endangered species.

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# 4.0 FUTURE SITUATION

## 4.1 Population and Land Use

### 4.1.1 Population

The facilities planning consultant has developed population forecasts for the overview area and the City of Detroit. Existing population forecasts available for the study area were not acceptable to all jurisdictions involved, or the forecasts did not cover the study area in a manner which could be disaggregated for use in the study.

The facilities planning consultant projected population using a mathematical model. This model closely resembles a logistic curve, a form of an exponential growth function. The model utilizes past trends, plus a modifying factor which identifies the year of initiation of strong growth. The modifying factor was included to improve accuracy of the forecasts in undeveloped areas.

This method of projecting population does have major drawbacks in that it relies heavily on past trends. However all population forecasts rely, to some extent, on past trends with differing degrees of modifications.

The method of forecast and results of the modeling effort were agreed to by SEMCOG, representatives of Wayne, Oakland, and Macomb Counties, and the City of Detroit for use in this planning effort. The projections are presented in Table 4.1-A. These projections indicate an increase in the overview planning area from 4,125,000 in 1977 to 5,206,000 in 2020 (Giffels/Black and Veatch, 1977, Book V).

The population forecasts of the SFP are not directly comparable to any other existing projections due to the area of coverage, the date of the forecast and the conditions surrounding the forecasts. The only forecast which could be compared to the SFP forecast is that of OBERS prepared in 1973-1974.

The OBERS projection covers all of Wayne, Oakland and Macomb Counties. The southern portion of Wayne County is not included within the SFP forecast. For purposes of comparison, the southern portion of Wayne County was assumed to grow at the same rate as the remainder of Wayne County. The comparison of the SFP and the OBERS projections (Table 4.1-B) shows that the variance is not significant (+4.78%) considering the length of forecast period.

Further comparison of the two population forecasts indicates that the southern part of Wayne County may exceed the projected average OBERS growth rate for the region. Therefore the actual difference between the OBERS projections and the OP/EA may be less than shown.

## Table 4.1-A

## Study Area Population Projections

| Minor Civil Divisions | 1970 | 1980 | 1990 | 2000 | 2010 | 2020 |
|---|---|---|---|---|---|---|
| Detroit | 1,514,063 | 1,463,042 | 1,430,724 | 1,409,849 | 1,396,193 | 1,387,187 |
| Allen Park | 40,747 | 46,709 | 48,590 | 48,590 | 46,705 | 45,144 |
| Canton Twp. | 11,026 | 33,654 | 71,913 | 101,964 | 114,351 | 114,351 |
| Dearborn | 104,199 | 103,726 | 103,308 | 102,938 | 102,610 | 102,320 |
| Dearborn Heights | 80,069 | 85,250 | 85,250 | 81,905 | 79,138 | 76,825 |
| Garden City | 41,864 | 45,639 | 45,639 | 43,079 | 41,028 | 39,358 |
| Grosse Pointe | 6,637 | 6,427 | 6,371 | 6,321 | 6,278 | 6,239 |
| Grosse Pointe Farms | 11,701 | 11,422 | 11,184 | 10,980 | 10,804 | 10,652 |
| Grosse Pointe Park | 15,641 | 15,220 | 14,863 | 14,558 | 14,297 | 14,072 |
| Grosse Pointe Shores | 3,042 | 3,401 | 3,401 | 3,333 | 3,275 | 3,224 |
| Grosse Pointe Woods | 21,878 | 21,878 | 21,158 | 20,555 | 20,046 | 19,612 |
| Hamtramck | 26,783 | 26,703 | 26,633 | 26,570 | 26,514 | 26,465 |
| Harper Woods | 20,186 | 19,787 | 19,444 | 19,148 | 18,892 | 18,669 |
| Highland Park | 35,444 | 35,292 | 35,158 | 35,039 | 34,933 | 34,840 |
| Inkster | 38,595 | 43,121 | 44,814 | 44,814 | 42,978 | 41,464 |
| Livonia | 110,109 | 135,084 | 141,686 | 141,686 | 133,676 | 127,264 |
| Melvindale | 13,862 | 14,731 | 14,731 | 14,449 | 14,207 | 13,999 |
| Northville | 5,400 | 6,526 | 7,247 | 7,651 | 7,860 | 7,860 |
| Northville Twp.* | 9,522 | 20,129 | 34,107 | 45,809 | 52,426 | 55,368 |
| Plymouth | 11,758 | 13,125 | 13,835 | 13,835 | 13,609 | 13,414 |
| Plymouth Twp. | 17,497 | 31,507 | 44,663 | 52,768 | 56,543 | 56,543 |
| Redford Twp. | 71,901 | 69,424 | 67,356 | 65,614 | 64,135 | 62,872 |
| Romulus* | 22,879 | 37,723 | 54,394 | 68,744 | 78,530 | 84,191 |
| Van Buren Twp.* | 13,162 | 18,218 | 25,217 | 48,409 | 73,162 | 90,113 |
| Wayne | 21,054 | 24,437 | 26,548 | 27,732 | 27,732 | 26,767 |
| Westland | 86,749 | 111,349 | 127,181 | 135,648 | 139,731 | 139,731 |
| Addison Twp.-Leonard | 2,809 | 4,157 | 6,153 | 9,106 | 11,233 | 12,289 |
| Avon Twp. | 24,513 | 43,948 | 62,043 | 73,119 | 78,259 | 78,259 |
| Berkley | 21,879 | 21,259 | 20,736 | 20,290 | 19,909 | 19,581 |
| Beverly Hills | 13,593 | 15,357 | 15,357 | 14,757 | 14,260 | 13,845 |
| Bingham Farms-Franklin | 3,910 | 5,064 | 5,906 | 6,422 | 6,704 | 6,704 |
| Birmingham | 26,170 | 28,289 | 29,366 | 29,366 | 28,913 | 28,520 |
| Bloomfield Hills | 3,672 | 4,556 | 4,983 | 5,155 | 5,155 | 4,962 |
| Bloomfield Twp. | 42,768 | 65,157 | 72,851 | 72,851 | 69,651 | 67,026 |
| Brandon Twp.-Ortonville | 4,813 | 6,411 | 8,503 | 11,214 | 14,681 | 19,043 |
| Clarkston-Independence | 17,361 | 25,694 | 38,028 | 51,388 | 63,664 | 73,270 |
| Clawson | 17,617 | 18,430 | 18,430 | 17,597 | 16,915 | 16,350 |
| Commerce Twp.* | 14,556 | 21,543 | 33,056 | 41,145 | 45,216 | 46,923 |
| Farmington | 10,329 | 13,693 | 15,205 | 15,205 | 14,792 | 14,442 |
| Farmington Hills | 48,694 | 72,951 | 91,296 | 101,603 | 106,451 | 106,451 |
| Ferndale | 30,850 | 30,316 | 29,856 | 29,457 | 29,110 | 28,808 |
| Groveland Twp.* | 2,570 | 3,804 | 5,357 | 6,720 | 7,692 | 8,287 |
| Hazel Park | 23,784 | 23,090 | 22,504 | 22,007 | 21,581 | 21,216 |
| Highland Park* | 8,372 | 12,391 | 18,338 | 23,333 | 26,586 | 28,364 |
| Holly* | 4,355 | 5,802 | 7,908 | 9,450 | 10,357 | 10,824 |

## Table 4.1-A (continued)

## Study Area Population Projections

| Minor Civil Divisions | 1970 | 1980 | 1990 | 2000 | 2010 | 2020 |
|---|---|---|---|---|---|---|
| Holly Twp.* | 3,041 | 4,052 | 5,400 | 7,196 | 9,590 | 12,780 |
| Huntington Woods | 8,536 | 8,184 | 7,894 | 7,653 | 7,449 | 7,277 |
| Keego Harbor | 3,092 | 3,386 | 3,637 | 3,844 | 4,009 | 4,138 |
| Lake Angelus | 573 | 1,130 | 1,758 | 2,211 | 2,442 | 2,539 |
| Lake Orion | 2,921 | 2,980 | 2,980 | 2,947 | 2,918 | 2,892 |
| Lathrup Village | 4,676 | 5,373 | 5,725 | 5,725 | 5,490 | 5,297 |
| Lyon Twp.* | 4,500 | 6,660 | 10,345 | 15,571 | 22,450 | 30,667 |
| Madison Heights | 38,599 | 42,425 | 44,975 | 46,577 | 46,577 | 45,111 |
| Milford* | 4,699 | 5,904 | 6,681 | 7,105 | 7,316 | 7,316 |
| Milford Twp.* | 2,557 | 3,784 | 5,601 | 8,262 | 11,177 | 13,860 |
| Novi-Novi Twp. | 9,850 | 14,578 | 25,000 | 36,831 | 46,778 | 53,238 |
| Oakland Twp. | 4,793 | 7,094 | 10,499 | 15,538 | 22,996 | 34,034 |
| Oak Park | 36,762 | 36,065 | 35,466 | 34,948 | 34,500 | 34,109 |
| Orchard Lake | 1,487 | 1,863 | 2,218 | 2,521 | 2,760 | 2,935 |
| Orion Twp. | 14,189 | 21,000 | 29,507 | 34,675 | 37,063 | 37,063 |
| Oxford | 2,536 | 2,729 | 2,936 | 3,159 | 3,921 | 4,425 |
| Oxford Twp. | 5,953 | 8,810 | 13,039 | 19,298 | 28,681 | 34,929 |
| Pleasant Ridge | 3,989 | 3,915 | 3,852 | 3,797 | 3,750 | 3,708 |
| Pontiac | 85,279 | 89,204 | 92,179 | 94,385 | 95,996 | 95,996 |
| Pontiac Twp. | 12,646 | 17,850 | 25,169 | 30,203 | 32,877 | 34,105 |
| Rochester | 7,054 | 7,316 | 7,316 | 7,280 | 7,248 | 7,221 |
| Rose Twp.* | 2,502 | 3,703 | 5,480 | 7,976 | 11,482 | 16,276 |
| Royal Oak | 86,238 | 85,260 | 84,406 | 83,660 | 83,006 | 82,431 |
| Royal Oak Twp. | 7,950 | 7,834 | 7,734 | 7,647 | 7,571 | 7,505 |
| Southfield | 69,298 | 105,999 | 125,122 | 131,993 | 131,993 | 127,466 |
| South Lyon* | 2,675 | 3,959 | 5,118 | 5,736 | 6,002 | 6,002 |
| Springfield Twp. | 4,388 | 6,494 | 9,389 | 12,867 | 16,596 | 20,136 |
| Sylvan Lake | 2,219 | 2,388 | 2,514 | 2,605 | 2,668 | 2,668 |
| Troy | 39,419 | 67,989 | 96,385 | 116,094 | 126,619 | 131,463 |
| Walled Lake | 3,759 | 5,792 | 7,189 | 7,870 | 8,148 | 8,148 |
| Waterford Twp. | 59,123 | 72,880 | 81,049 | 85,186 | 85,186 | 82,521 |
| West Bloomfield Twp. | 28,563 | 49,046 | 68,365 | 80,927 | 87,245 | 90,014 |
| White Lake Twp.* | 14,311 | 21,180 | 31,347 | 40,856 | 49,016 | 55,050 |
| Wixom* | 2,010 | 3,450 | 5,354 | 7,376 | 9,078 | 10,253 |
| Wolverine Lake* | 4,301 | 5,187 | 5,429 | 5,429 | 5,176 | 4,970 |
| Armada-Armada Twp. | 2,953 | 4,468 | 6,641 | 9,625 | 13,491 | 18,136 |
| Bruce Twp. | 2,213 | 4,773 | 9,443 | 16,228 | 23,420 | 28,894 |
| Centerline | 10,379 | 10,145 | 9,945 | 9,774 | 9,626 | 9,498 |
| Chesterfield Twp. | 9,378 | 20,644 | 40,351 | 65,949 | 88,869 | 103,493 |
| Clinton Twp. | 48,865 | 79,569 | 108,808 | 129,098 | 140,286 | 145,686 |
| East Detroit | 45,920 | 44,152 | 42,688 | 41,462 | 40,427 | 39,547 |
| Fraser | 11,868 | 18,017 | 20,521 | 20,521 | 19,498 | 18,668 |
| Harrison Twp. | 18,755 | 31,475 | 42,667 | 49,470 | 52,721 | 52,721 |
| Lenox Twp. | 2,869 | 3,494 | 6,248 | 11,013 | 18,940 | 31,306 |
| Macomb Twp. | 6,140 | 7,843 | 17,261 | 35,467 | 64,580 | 99,481 |

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## Table 4.1-A (continued)

## Study Area Population Projections

| Minor Civil Divisions | 1970 | 1980 | 1990 | 2000 | 2010 | 2020 |
|---|---|---|---|---|---|---|
| Memphis-Richmond Twp. | 2,468 | 3,587 | 5,154 | 7,287 | 10,085 | 13,581 |
| Mount Clemens | 20,476 | 20,317 | 20,177 | 20,054 | 19,946 | 19,851 |
| New Baltimore | 4,132 | 7,923 | 11,959 | 14,718 | 16,083 | 16,651 |
| New Haven | 1,855 | 2,745 | 3,000 | 3,000 | 3,000 | 3,000 |
| Ray Twp. | 2,683 | 3,451 | 4,438 | 8,560 | 15,886 | 27,626 |
| Richmond | 3,234 | 5,028 | 6,317 | 6,975 | 7,253 | 7,253 |
| Romeo | 4,012 | 4,200 | 4,200 | 4,200 | 4,165 | 4,135 |
| Roseville | 60,529 | 64,268 | 64,268 | 62,663 | 61,298 | 60,130 |
| Shelby Twp. | 29,467 | 43,611 | 71,971 | 89,502 | 96,588 | 96,588 |
| Sterling Heights | 61,365 | 122,373 | 167,851 | 186,767 | 186,767 | 178,661 |
| St. Clair Shores | 88,093 | 94,350 | 94,350 | 90,547 | 87,407 | 84,787 |
| Utica | 3,504 | 4,183 | 4,558 | 4,738 | 4,738 | 4,689 |
| Warren | 179,260 | 188,513 | 188,512 | 179,747 | 172,594 | 166,682 |
| Washington Twp. | 5,651 | 8,363 | 18,698 | 34,283 | 49,442 | 59,048 |
| Total (Rounded) | 3,889,000 | 4,398,000 | 4,878,000 | 5,240,000 | 5,484,000 | 5,632,000 |
| Total Overview Plan Study Area (Rounded)** | 3,782,000 | 4,241,000 | 4,653,000 | 4,938,000 | 5,111,000 | 5,206,000 |

* These MCD's are outside of the Overview Plan Study Area and are included only to facilitate comparison with other regional estimates.

** This total excludes the MCD's marked with an asterisk.

Table 4.1-B

Comparison of SFP Population Forecasts
with OBERS Series "E"

| | 1980 | 1990 | 2000 | 2020 |
|---|---|---|---|---|
| Study Area | 4,241,000 | 4,653,000 | 4,938,000 | 5,206,000 |
| Study area plus southern Wayne Co. | 4,753,700 | 5,272,400 | 5,663,600 | 6,097,250 |
| OBERS "E" | 4,589,700 | 5,005,300 | 5,332,600 | 5,820,800 |

On a local basis, the projections show that most of the growth will occur in the suburban portions of the study area with the majority occurring in Macomb and Oakland Counties. Most of the urban areas in and around the City of Detroit are expected to lose population during the planning period. The losses of the urban areas are forecasted to be gains in the suburban area.

The population forecasts indicate that several areas which have had proposals for interceptors in previous plans, may not have sufficient population density to require or economically justify sewers. Specifically, sewage collection systems have been proposed for the northern portion of Macomb County. The townships to have been served are Armada, Bruce, Ray, Richmond, and Washington. Development/density trends in all but Washington Township indicate that the projected population could be supported with onsite disposal systems rather than collection and treatment. While development could occur in any of these township(s) in sufficient density to require some alternative to onsite disposal of wastewater, the actual location of the population centers cannot be determined at this time.

### 4.1.2 Land Use

Land use projections by the facilities planning consultant were made to coincide with projected population increases and for use in estimating runoff from various land uses. Results of the analysis show land attributed to railroads, right-of-way, extractive, water, agriculture, and cemetery uses to remain constant from 1970 to 2020. Land was attributed to residential uses at a medium or high density only in areas presently having such densities.

The commercial acreage in the study area is projected to increase from 19,465 in 1970 to 29,077 in 2020; the industrial acreage from 32,682 to 43,019; and residential acreage from 250,666, to 427,007 acres. The residential acreage is forecast to occur in north central Macomb and Oakland Counties as urban infilling and sprawl continues. No specific location for commercial and industrial acreage can be identified, as the increase is expected to be scattered throughout the region.

## 4.2 Economic Projections

A regional econometric model was used by the facilities planning consultant to project regional control totals of income, population and employment. These totals were then disaggregated using county share projection models. The basis for these models has been well documented (Mattila, 1973 and Moor, 1976).

Results of the model are directly comparable with OBERS projections in the employment and personal income categories (Table 4.2-A).

Comparison of the data show large gains in employment and very moderate personal income growth resulting from the Detroit model. Further analysis relating population to employment and income is presented in that same table using the adjusted population projections for the SMSA area (assuming southern Wayne County to have a growth rate equivalent to the study area).

Results of this comparison show a major deviation in the employment/population ratio for the short term, with the similar results achieved by the year 2020. However, comparison of per capita income projections shows major divergence by the end of the forecast period. These differences do not make a significant impact upon population forecasts contained in this study.

## 4.3 Forecasts of Flow and Waste Load

Peak dry weather flows expected at the DWWTP, as developed by the facilities planning consultant, are shown in Table 4.3-A. The decrease between 1975 and 1980 reflects the elimination of considerable high stage river inflow. The data show expected flow with and without the communities of Pontiac, Warren, etc. that are presently treating their own wastewater.

Should suburban flows be required for evaluating wastewater treatment plant sites other than at DelRay, the suburban average dry weather flows should be multiplied by a peaking factor dependent on tributary population (but not less than 1.5).

While not connected to the DWSD sewer system, per capita flows have been assumed for the communities of Rochester, Pontiac, Sylvan Lake, and Warren. The first three were assumed to have future per capita flows of 130 gcd (0.49 $m^3$/cd) (similar to Clinton-Oakland district); Warren was rated at 121 gcd (0.46 $m^3$cd) similar to South Macomb Sanitary District.

## Table 4.2-A

### Comparison of SFP Population, Employment and Income With OBERS Series "E"

| | 1980 | 1990 | 2000 | 2020 |
|---|---|---|---|---|
| Population | | | | |
| Study area plus southern Wayne Co. | 4,753,700 | 5,272,400 | 5,663,600 | 6,097,250 |
| OBERS "E" | 4,589,700 | 5,005,300 | 5,332,600 | 5,820,800 |
| Employment | | | | |
| Study area plus* southern Wayne Co. | 1,575,000 | 1,860,800 | 2,147,700 | 2,669,100 |
| OBERS "E" | 1,965,500 | 2,157,900 | 2,379,200 | 2,558,700 |
| Employment/Pop. Ratio | | | | |
| Study area plus southern Wayne Co. | 0.33 | 0.35 | 0.38 | 0.44 |
| OBERS "E" | 0.43 | 0.43 | 0.45 | 0.44 |
| Personal Income** | | | | |
| Study area plus* southern Wayne Co. | 27,724,000 | 34,877,000 | 41,226,000 | 58,745,000 |
| OBERS "E" | 25,893,800 | 35,930,300 | 50,026,400 | 87,485,200 |
| Per Capita Income** | | | | |
| Study area plus southern Wayne Co. | $5,830 | $6,615 | $7,280 | $9,650 |
| OBERS "E" | $5,600 | $7,100 | $9,300 | $15,000 |

* excludes the agriculture and mining sectors
** thousands of 1967 dollars

Table 4.3-A

Peak Dry Weather Flow by Decade

| | | 1976 (mgd) | 1980 (mgd) | 1990 (mgd) | 2000 (mgd) |
|---|---|---|---|---|---|
| Detroit: | Infiltration | 31 | 30 | 30 | 29 |
| | Unaccounted for | 45 | 45 | 45 | 45 |
| | Peak DWF less I/I | 334 | 330 | 325 | 324 |
| Suburban | | 340 | 474 | 583 | 627 |
| River Inflow | | 39 | 25 | 25 | 25 |
| Total to WWTP(s) | | 789 | 904 | 1008 | 1050 |
| Pontiac and Warren* | | 78 | 82 | 80 | 80 |
| Study Area Total | | 867 | 986 | 1088 | 1130 |

*Plus Rochester through 1980

The average dry weather flow from the planning area (Detroit), the service area and the study area, by decade, are summarized in Table 4.3-B.

Projected year 2000 wastewater characteristics used for the basis of design are shown below. These characteristics were projected based on current characteristics and flows, and current and future projected population assuming similar per capita contributions in the year 2000 as at present.

| | |
|---|---|
| BOD | |
| Average Concentration | 115 mg/l |
| SS | |
| Average Concentration | 245 mg/l |
| Phosphorus (total) | |
| Average Concentration | 5.5 mg/l |

Projections for other parameters wastewater characteristics were not made by the facilities planning consultants.

## 4.4 Water Quantity and Quality

Further degradation of surface water quality in the study area can be expected to occur if the proposed action is not implemented (Giffels/Black and Veatch, 1977, Book VI). Most of the modeled water quality parameters are expected to continue meeting the receiving water quality standards even though concentrations at almost every station will increase for almost every parameter. In most portions of the Rouge and Clinton River's total dissolved solids, suspended solids, and ammonia are presently in compliance with standards but will not be in the future, due primarily to increased runoff. Phosphorus concentrations and fecal coliform counts are currently not in compliance with standards and will further degrade.

## Table 4.3-B

## Average Dry Weather Flow By Decade

| | 1975 (mgd) | 1976 (mgd) | 1980 (mgd) | 1990 (mgd) | 2000 (mgd) | 2020 (mgd) |
|---|---|---|---|---|---|---|
| Detroit: Infiltration | 31 | 31 | 30 | 29 | 29 | 29 |
| Avg. DWF - Infil. | 223* | 223* | 220 | 217 | 216 | 215 |
| Avg. DWF | 254 | 254 | 250 | 246 | 245 | 244 |
| Dry weather overflow** | 7 | 11 | 0 | 0 | 0 | 0 |
| Unaccounted for Water | 46 | 45 | 45 | 45 | 45 | 45 |
| Total Avg. DWF | 307 | 310 | 295 | 291 | 290 | 289 |
| Suburban DWF | 227 | 227 | 316 | 389 | 418 | 457 |
| Subtotal | 534 | 537 | 611 | 680 | 708 | 746 |
| River Inflow | 52 | 39 | 25 | 25 | 25 | 25 |
| Total Service DWF# | 585# | 576# | 636 | 705 | 733 | 771 |
| Pontiac and Warren (*plus Rochester) | 46* | 53* | 55* | 54 | 53 | 53 |
| Total Study Area DWF | 632 | 629 | 691 | 759 | 786 | 824 |

# This computation gives results within four per cent of the 563 mgd calculated from flows pumped at the DWWTP

**Giffels/Black and Veatch, 1977, Book I, p. 5-25

Mile points 19.0 and 3.9 of the Detroit River do not presently and will not meet fecal coliform standards due to increased runoff and CSO's. Phosphorus standards are met at Mile Point 30.8 and 19.0 along the Detroit River but, due to municipal and industrial discharges, will not meet standards anywhere along its length in the future.

In all probability, because of future changes in land use patterns, storm runoff will increase resulting in an increase in the frequency and extent of flooding. Also, due to the more impervious surfaces and altered soil cover, groundwater recharge will be decreased. Groundwater quality is expected to improve due to the elimination of septic tanks and cesspools as more people within the three county area discharge their wastewater to a collection system (Giffels/Black and Veatch, 1977, Book XIV).

## 4.5 Air Quality

No significant change in the climate of the study area is expected within the study period whether the proposed action is implemented or not.

Suspended particulates and photochemical oxidant concentrations, which currently exceed ambient air quality standards, are expected to decrease within the study period whether the proposed action is implemented or not. Current and future air pollution control plans would generally improve the air quality in the study area as they are implemented.

## 4.6 Cultural Resources

Changes in human interest resources will occur during the study period. Continued growth and development will cause noticeable changes in recreational resources. More land will be designated for recreation and open space, mostly in the form of neighborhood and community parks and playgrounds. The Regional Recreation and Open Space Plan proposes approximately 10,500 acres of new parks and park additions by the year 1990 and 5,000 acres in proposed game preserves and natural areas. Continued population growth and an increase in leisure time activity will result in more intensive weekend usage of county, state and regional park areas and water related recreation.

Continued growth and development will additionally result in the removal of familiar landmarks such as old farmhouses and barns. New historical sites will be added to the National Register of Historic Places and additional archaeological sites will be discovered. Urban encroachment, however, will probably disrupt or conceal many more of these sites.

## 4.7 Rare and Endangered Species

The numbers of rare and endangered species and their respective populations are not expected to change dramatically during the planning period. Continued urbanization and resulting water quality will most likely cause reductions to some extent in both numbers and populations. These impacts are expected to occur with or without the project and are not a result of the policies and practices of DWSD on a regional scale.

## 4.8 Summary

This chapter predicts the quality of the future environment if the recommended plan is not implemented and also forms the no action alternative. NEPA requires that a no action alternative be evaluated with other alternatives. The information presented in this chapter is compared with the impacts of the feasible alternatives in Chapter 5.0.

## 5.0 ALTERNATIVES ANALYSIS

The analysis of the alternatives is a two-part, three-phase analysis. The collection and treatment analysis is separated from the sludge analysis for simplification. Each of the two parts is subjected to a three-phase analysis which: (1) identifies possible components of the system and its subsystems; (2) combines the system components into alternatives for screening to determine the feasible alternatives; and (3) evaluates the feasible alternatives to arrive at the recommended plan.

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# 5.0 ALTERNATIVES ANALYSIS

## 5.1 Collection and Treatment Components Alternatives

This section introduces the various collection and treatment components that could be combined into a system alternative. Some of the proposed alternatives are discussed in more detail than others. In the screening of alternatives, compatible components are organized into collection and treatment systems.

### 5.1.1 Collection Component Alternatives

The proposed collection alternatives are designed to reduce the frequency and volume of combined sewer overflows and local flooding of basements.

The principal mechanisms for achieving these objectives are the storage and retention of wastewater for peak flow reduction, the separate transport of suburban sanitary flow, and the continued separation of sanitary and storm sewers in the suburbs. The following alternatives were investigated by the facilities planning consultant (Giffels/ Black and Veatch, 1977, Book XI).

#### 5.1.1.1 Storage and Retention for Peak Flow Reduction

Storage and retention of wastewater to reduce peak flows can be accomplished by insystem storage, retention basins, or deep tunnels.

Insystem storage would utilize remotely controlled devices, such as fabridams, to provide additional retention volume in several of the existing relief sewers.

Covered retention basins would be constructed at numerous, off-system sites with dual use as recreational land. Some specific site alternatives have been analyzed:

- Construct a basin on land to be purchased immediately north of the DWWTP. Combined sewage in excess of DWWTP's capacity will be pumped into this basin and drain back into the interceptor when flow rates subside. A sixty acre (24 ha) basin, 30 feet (9.0m) deep, has a capacity of 560 million gallons (2,100,000 $m^3$);
- Construct a basin in Alfred Brush Ford Park with a tunnel connection to the Fox Creek Enclosure to reduce the frequency of combined sewer overflows into Fox Creek;
- Construct retention basins in the City of Grosse Pointe Park with a tunnel system for return flow into the Detroit River Interceptor;

- Construct basins in the City of Detroit with sufficient capacity to retain overflows from Grosse Pointe Park. Wastewater will be returned to the Detroit River Interceptor; and
- Construct a basin near Conners Creek to hold combined sewage during storms and return it to either the Detroit River Interceptor or the North Interceptor - East Arm. Holding facilities will complement riverfront improvements. Preliminary treatment consisting of screening, skimming, or grit removal is planned for this retention basin.

Possible tunnel alternatives are as follows:

- Construct a tunnel parallel to the NI-EA (presently under construction); and
- Construct a deep tunnel from 15 Mile Road to the DWWTP with a capacity of 150 million gallons (567,750 $m^3$).

#### 5.1.1.2 Transport of Separate Sanitary Flow from Suburbs

Many of the suburbs have separate storm and sanitary sewers. An alternative was suggested which would route the sanitary flow directly to the treatment plant in separate interceptors. Since the total flow to the DWWTP will be the same, this alternative will have little impact upon the volume of combined sewer overflow, but will decrease their strength. The alternative would consist of constructing pumping stations and force mains to segregate suburban sanitary flows in southern Oakland County and western Wayne County from the Detroit system and transport them directly to the treatment plant.

#### 5.1.1.3 East Arm Alternatives

The alternative components listed in this section include using pump stations and rerouting flows in existing sewer lines to reduce CSO. Some general management measures to control flows are also included.

There are several alternatives for the East Arm.

- Relieve the lower reaches of the Detroit River Interceptor by pumping from the Fairview or the Connors Creek Pumping Station to the NI-EA;
- Divert dry weather flows, relieve combined sewers, and provide interception capacity from Detroit's combined sewers to the NI-EA. Flow control facilities will be

constructed at the following locations to direct designated flows to the interceptor:

- Meldrum near Gratiot and Meldrum
- Conant - Mt. Elliott near Gratiot and Mt. Elliott
- First Hamilton near Myrtle and Fourth
- Clark near Fort and Summit
- Morrell near Fort and Morrell
- Cavalry Junction near Fort and Cavalry
- Livernois Relief near Fort and Dragoon; and

- Reduce CSO in Oakland County by constructing the southeast Oakland Arm of the North Interceptor - East Arm from near 7 Mile Road and Conant - Mt. Elliott to the North Interceptor - East Arm near 7 Mile Road and Van Dyke.

Positive backflow prevention devices can be used at all river outlets to prvent inflow.

General management alternatives can be implemented throughout the entire service area.

- Limit flows accepted into the Detroit system from suburban areas and thereby require suburbs to provide their own facilities to handle flows that exceed predetermined or contractual maximums; and
- Reduce flows through administrative measures such as increasing water and wastewater rates, limiting the area served to the capacity of the existing system, and reducing catch basin inlet areas.

#### 5.1.1.4 West Arm Alternatives

The West Arm Alternatives are proposed to reduce CSO and transport separate sanitary sewage to the DWWTP. The existing Oakwood Northwest Interceptor has insufficient capacity to handle peak dry weather flow (Section 3).

Possible alternatives for the West Arm are as follows:

- Improve the existing collection system in the River Rouge (not to be confused with the City of River Rouge) watershed by adding stormwater retention basins to limit overflow occurrences to 12, 4 or 1 per year;
- Construct the West Arm Interceptor from 8 Mile Road to the DWWTP in conjunction with some retention facilities as first suggested in the 1966 National Sanitation Foundation study. Flows beyond the DWWTP capacity will overflow to the Detroit River;

- Construct a tunnel under the River Rouge to relieve siphons on the Northwest Interceptor and provide increased capacity for Northwest and Oakwood flows without hydraulic interference from Baby Creek;
- Remove the sanitary flow fraction in the Southfield District by routing flow from the Evergreen and Farmington Districts to the First Hamilton Sewer which has excess capacity. Such rerouting will reduce the strength of the combined sewage that overflows to the River Rouge;
- Construct a pumping station and force main to augment the existing Hubbell and Southfield Districts to achieve results similar to the West Arm Interceptor Tunnel. Flows beyond the capacity of the DWWTP will overflow to the Detroit River;
- Construct two secondary sewage treatment plants -- one to serve the Evergreen-Farmington and Farmington Districts, and one to serve the Middle River Rouge and western areas. The effluent from these plants would be discharged to the Detroit River through a force main; and
- Construct two advanced sewage treatment plants -- one to serve the Evergreen-Farmington and Farmington Districts, and one to serve the Middle River Rouge and western Wayne County. These sewage treatment plants would discharge effluent to the River Rouge.

#### 5.1.1.5 Sewer Separations

This alternative involves the separation of all sanitary wastewater from stormwater. The existing combined sewers could be utilized as storm sewers while a parallel sanitary sewer could be constructed to convey sanitary sewage and industrial wastes to treatment facilities. This alternative would be proposed for the entire study area.

### 5.1.2 Treatment Components Alternatives for DWWTP

The discussion in this section centers on the main treatment components of the DWWTP. The alternatives are based on improvements to, or replacement of, existing facilities (Giffels/Black and Veatch, 1977, Book XII).

#### 5.1.2.1 Preliminary Treatment

Alternatives for preliminary treatment include:

- Further upgrading of existing equipment, along with planned improvements; and
- Complete replacement of the preliminary treatment facilities. This would improve preliminary treatment by using aerated grit chambers, more accurate flow metering, and efficient chemical mixing.

### 5.1.2.2 Primary Treatment

Primary treatment performs an important function in reducing loadings on the secondary system. For this reason, considerable attention was given to improving the performance of primary treatment.

Alternatives which were evaluated include:

- Add two more circular tanks, A5 and A6;
- Replace the metal chain and flight sludge collectors in the rectangular tanks with a plastic chain and fiberglass flights;
- Replace the existing rectangular tanks with twenty square tanks, six (larger) square tanks, or six circular tanks;
- Increase sludge pumping capacity so that sludge could be withdrawn at one percent solids content. This would eliminate clogging and allow for better solids removal; and
- Replace skimming equipment on the circular tanks, and improve skimming on the rectangular tanks.

### 5.1.2.3 Secondary Treatment

Alternatives for secondary treatment of wastewater are grouped into minor changes which will improve the performance of the existing system and major changes to the existing system.

Alternatives for upgrading the existing secondary treatment system center around improving the sludge thickening characteristics of the secondary clarifiers.

Suggestions include:

- Change recycle rates;
- Add more clarifiers;
- Convert to center-feed units;
- Raise the influent point to mid-depth of the tank; and
- Reverse the primary and secondary units.

A major change to the existing system is introduced in an alternative that substitutes a chemical/physical treatment for conventional secondary treatment. This option is considered because raw wastewater received at the DWWTP is relatively low in soluble BOD. Monthly averages of soluble BOD in the influent do not consistently fall below the required effluent standard of 30 mg/l. Consequently, some degree of soluble BOD removal must be provided for at least part of the flow. The resulting "split treatment" scheme developed in the SFP (Giffels/Black and Veatch, 1977, Book XII) would utilize 300 mgd (1,100,000 $m^3$/d) of the existing biological secondary treatment facilities to achieve a net $BOD_5$ of 30 mg/l. Biological secondary treatment was chosen over carbon absorption because the treatment units are already installed and operating and plant personnel are familiar with biological treatment.

The major modifications to the existing plant identified by the facilities planning consultant (Giffels/Black and Veatch, 1977, Book XII) for the "split treatment" alternative include:

- Construct the proposed new pumping, aerated grit, screening, chemical mixing, and flow measurement facilities;
- Provide the capability to feed 20 mg/l of ferric chloride (as iron);
- Convert twelve secondary sedimentation basins to primary units;
- Construct new 150 feet (46 m) square primary basins;
- Provide a filter complex with 132,000 square feet (12,400 $m^2$) of mixed media filter surface area;
- Convert four secondary sedimentation basins to backwash storage and chlorine contact basins and provide backwash pumping capacity;
- Operate 300 mgd (1,100,000 $m^3$/d) of oxygen activated sludge capacity and nine renovated secondary clarifiers. (The area currently utilized by the remaining aeration facilities would be occupied by new unit processes);
- Provide new chlorination facilities;
- Modify intermediate pumping capability to accommodate use of secondary basins as primaries and continued operation of 300 mgd (1,100,000 $m^3$/d) of secondary capacity;
- Provide additional sludge handling capability, including pumping, thickeners and vacuum filters; and
- Operate six circular primary clarifiers (four "given" and two to be constructed).

### 5.1.2.4 Phosphorus Removal

Alternatives considered for phosphorus removal by the SFP (Giffels/Black and Veatch, 1977, Book XII) included:

- Add a flocculation zone to the circular primary clarifiers. It is not practical to add flocculation to the rectangular clarifiers, due to space limitations;
- Various changes to the chemical feed system to allow better control and more even distribution;

- Supplement ferrous chloride ($FeCl_2$) additions with ferric chloride ($FeCl_3$) to provide iron in sufficient quantities for phosphorus removal;
- Convert ferrous chloride to ferric chloride by oxidation with chlorine. Additional ferric chloride would also be added;
- Use ferric chloride, alum and polymer in conjunction with replacement of preliminary treatment units;
- Lime treatment to precipitate phosphorus as hydroxyapatite. This would include lime feeding facilities, additional solids handling equipment, and additional sedimentation facilities; and
- Convert to the PhoStrip process, which utilizes biological release of phosphorus from sludge under anaerobic conditions (This does not constitute EPA endorsement of the process). The activated sludge absorbs phosphorus in the aeration tanks and then is held in a tank under anaerobic conditions where phosphorus is released to the liquid. The settled sludge is sent back to the aeration tank while the concentrated phosphorus in the liquid is precipitated with lime.

#### 5.1.2.5 Disinfection

Alternatives for disinfection include:

- Renovate the existing system to extend its useful life and to remedy existing safety hazards, e.g. lack of leak detection equipment;
- Replace the existing facilities (which would be converted into laboratory space) with new liquid chlorine facilities;
- Use ozone with recapture of oxygen. The ozone would be generated from surplus plant oxygen. Contact basins would be required for recapturing oxygen, as recapture is not possible in the effluent conduit; and
- On-site generation of sodium hypochlorite.

#### 5.1.2.6 DWWTP Expansion

Availability of space for expansion at DWWTP has been a problem. Most of the area is heavily industrialized, although the northeast side of the site borders a church and a residential area. Sentiment expressed at Public Meeting Number Two indicates that reasonably compensated relocation might now be welcomed by DelRay residents. If this is the case, the purchase of the 85 acre (34 ha) residential area would allow up to a 400 mgd (1,500,000 $m^3/d$) expansion of primary and secondary treatment capacity.

### 5.1.2.7 Effluent Disposal Technique

- Disposal to Receiving Streams

Any expansion or upgrading alternatives at the DWWTP would continue effluent discharge to the Detroit River because of its huge assimilative capacity. Discharge criteria of the consent judgment were presented in Section 1.2.2.

- Treatment and Reuse Technique

No industrial customers were identified who would use treated wastewater for cooling or other processes. Because the Detroit River provides an abundant supply of water for the region, there is little incentive to reuse wastewater.

- Land Application of Liquid Effluent

All 201 facilities plans are required to consider land application as a disposal alternative. A regional plan for land application of wastewater was investigated by the U.S. Army Corps of Engineers (1974). The regional plan was not recommended because of higher costs compared to other alternatives and public opposition over the project's huge land requirements. Although land application of wastewater did not appear feasible on a regional basis, it was still considered as a sub-regional alternative.

Land requirements and costs for a 50 mgd (190,000 $m^3/d$) land application system were estimated according to "Costs of Wastewater Treatment by Land Application" (Pound et al., 1975) for a "Stage I" level of detail. Land requirements, including a buffer zone and space for an effluent holding basin, would total about 18,000 acres (7,300 ha). Since it would be impractical to assemble such a large parcel of land in the suburban areas, it was assumed that 50 miles (80 km) of force main would be required. At the application site, wastewater would be treated in aerated lagoons then stored for as long as six months during the winter. The cropping system would use corn plus a cover crop.

### 5.1.3 Treatment Component Alternatives for Other Facilities

This section explores the general alternative of constructing other treatment facilities which would be used in addition to, or as a replacement for, the DWWTP.

### 5.1.3.1 Treatment Plant Locations

- Treatment Facilities at Conners Creek

The existing interceptor system conveys large quantities of wastewater past the mouth of Connors Creek. Wastewater flow projections indicate that nearly 400 mgd (1,500,000 $m^3/d$) of dry weather flows could be directed to this site in the year 2000 without extensive sewer construction. The site itself, on the north side of Connors Creek, is subject to frequent flooding and is included as part of recreational development on the riverfront. Housing in the area is relatively old and redevelopment is under way. Although some residents would have to be relocated, development of wastewater treatment facilities could be coordinated with planned redevelopment and flood control. The Conners Creek site is upstream of the DWSD water intakes.

- Treatment Facilities on the Clinton River

A treatment facility on the Clinton River would serve the northeastern suburbs. Although it would eliminate the need for interceptors to convey wastewater downstream, a higher degree of treatment would be required because of the relatively low flow of the river during drought conditions. For the purpose of preliminary analysis, the recently abandoned Sterling Heights Wastewater Treatment Plant site was considered for a possible regional wastewater treatment plant.

- Treatment Facilities on the River Rouge

Treatment of separate sanitary sewage of subrban communities near the source would remove domestic sewage from combined sewer overflows further downstream and reduce interceptor costs. Projected wastewater flows for the year 2000 indicate that dry weather flows from Oakland County and western Wayne County will both approach 50 mgd (190,000 $m^3/d$).

Wastewater treatment plants have been considered near 8 Mile Road and near lower Rouge Park. As with the Clinton River, stringent effluent limitations were assumed necessary due to low summer flows.

- Wayne County Wyandotte Treatment Plant

Wastewater from the Rouge Valley could be diverted to the Wayne County Downriver Disposal District for treatment at the Wayne County Wyandotte Treatment Plant. The Wayne County Department of Public Works is considering expansion of the Wyandotte Plant and has requested that this alternative be examined (Bingham, 1977).

- Treatment Facilities at the Huron River

A treatment facility at the mouth of the Huron River has been discussed since 1965 (National Sanitation Foundation, 1965) but has not yet been implemented. Ann Arbor and Ypsilanti have since decided to construct their own treatment plants. The Huron River Plant, if implemented, would serve communities in the Huron River Valley and could also receive diversions of wastewater from the River Rouge Valley.

- Local Wastewater Treatment Plants

Small to medium-sized treatment plants could be constructed to serve specific local areas. This arrangement would be compatible with a decentralization policy for wastewater collection and treatment but would be a reversal of current planning. General plant locations would depend on the choice of service areas. Specific locations would be determined by the jurisdictions involved.

### 5.1.3.2 Effluent Disposal

- Disposal to Receiving Streams

Alternatives involving wastewater treatment plants at Connors Creek, Wyandotte, or the mouth of the Huron River would discharge to the Detroit River. Effluent limitations would be essentially the same as the expected NPDES permit limits for the DWWTP (Section 1.2.2).

The effluent limitations for 50 mgd (190,000 $m^3$/d) or larger treatment facilities will probably be much more stringent for discharges to the Upper Rouge and Clinton Rivers, due to their limited assimilation capacities at low flows. The facilities planning consultant (Giffels/Black and Veatch, 1977, Book XII) assumes that the effluent would have to meet additional BOD and SS requirements as well as the $NH_3N$ discharge limitation as follows:

| | |
|---|---|
| Suspended Solids | 5 mg/l |
| BOD | 5 mg/l |
| $NH_3$-N | 1 mg/l |
| Total Phosphorus | 1 mg/l |
| Dissolved Oxygen | 5 mg/l |
| Phenol | 10 μg/l |

The above levels were derived from a review of the Warren, Michigan, NPDES requirements. The City of Warren operates a tertiary facility that discharges to the Clinton River.

- Treatment and Reuse Technique

The previous discussion of treatment and reuse of wastewater for industrial processing (Section 5.1.2.7) applies to treated effluent from other facilities.

- Land Application of Liquid Effluent

Discussion of this technique will occur in Section 5.1.3.3.

### 5.1.3.3 Wastewater Treatment Processes

For preliminary costing purposes, facilities located at Conners Creek could be assumed to utilize the processes similar to DWWTP since both facilities would treat combined wastewater and discharge to the Detroit River. Any expansion of the Wyandotte Plant could, likewise, be assumed to use the same processes as the existing Wyandotte facilities.

Other plants, however, would treat predominately domestic wastewater and have to meet effluent limitations applicable to local streams. The following sections examine process combinations capable of meeting these stricter effluent limitations.

- Biological Tertiary Treatment

This alternative would use a two-stage activated sludge process to accomplish nitrification of the wastewater. Following pumping and preliminary treatment, ferric chloride and polymer would be used to remove phosphorus in the primary clarifiers. The first stage activated sludge units which include aeration tanks and secondary clarifiers would remove carbonaceous oxygen demand, while the second stage would remove nitrogenous oxygen demand. Chlorine would be used for disinfection, and finally, gravity filtration would ensure a high quality effluent. Sludge processing was assumed to be the same as that of the DWWTP, i.e. thickening, vacuum filtration, and incineration.

- Biological Secondary Treatment with Land Application

Application of wastewater to land can be considered a tertiary treatment process. Spray irrigation systems similar to that used in Muskegon, Michigan, can achieve $BOD_5$ and suspended solids removals of over 98 percent, nitrogen removal of over 85 percent depending upon crop uptake, and phosphorus removals of 80 to 99 percent (Pound et al., 1975).

A further disucussion of this alternative can be found in Section 5.1.2.7.

- Physical-Chemical Treatment

Physical-chemical treatment does not depend upon biological reactions for wastewater treatment. Phosphorus would be removed by two-stage lime precipitation and filtration. Carbon absorption would remove dissolved organic material. Nitrogen compounds would be removed by ion exchange. Solids handling would use incineration to recalcine or regenerate lime. Activated carbon would also be generated.

### 5.1.4 Treatment of Separate Sanitary Flow from Western System

Two treatment facilities for the West Arm area have been presented as alternatives for the West Arm (Section 5.1.1.4):

- Construction of two secondary treatment plants and gravity lines to transport suburban sanitary flows from southern Oakland County and mid-western Wayne County to these treatment plants. Effluent pumping stations would be constructed with a large diameter force main to pump the effluents to the Detroit River; and
- Construction of two tertiary treatment plants and gravity lines to transport suburban sanitary flows from southern Oakland County and midwestern Wayne County to these plants. Effluent from the treatment plants would discharge directly into the River Rouge.

### 5.1.5 Combined Sewer Overflow Treatment Methods

The purpose of CSO treatment is to remove aesthetically displeasing matter, reduce the quantity of settleable solids, and reduce the disease-causing potential of the overflows. Depending upon the methods of treatment, CSO can be treated to varying degrees of effluent quality by physical, physical-chemical, or biological processes. Another common control technique is to store overflows in retention basins, and to gradually dewater these basins to interceptors for treatment at regular treatment plants after the storm ends.

Various modes of operating stormwater treatment facilities are available. For purposes of comparison, ultimate disposal of residual wastes is not included in cost estimates for this section. Processes discussed here discharge concentrated wastes to nearby interceptor sewers.

Since removal of particulate matter is of primary importance, effective solids/liquid separation is considered in each option. Disinfection is essential for coliform reduction. Due to high quantities of grease and oil in the wastewater in Detroit, skimming CSO is considered essential.

Costs and arrangements of stormwater treatment facilities are based upon 50 mgd (190,000 $m^3$/d) capacity modules for simplicity in application to alternative systems. Monetary costs were computed as outlined in the SFP (Giffels/Black and Veatch, 1977, Book XIII). Table 5.1-A presents a brief description and evaluation of these facilities.

The issue of CSO is not completely resolved in the SFP. Resolution of this problem will occur in the final facilities plan.

### 5.1.6 Industrial Waste Treatment

In order to meet the requirements of PL 92-500 and 40 CFR 35.9 the DWSD will have to implement a user charge/industrial cost recovery system (UC/ICR). Industries now account for 137 mgd (518,545 $m^3$/d) out of the 650 mgd (2,460,250 $m^3$/d) dry weather wastewater flow.

Several alternatives were developed for treating industrial wastes separately:

- Construct and operate one or more specialized industrial waste treatment plants in areas of industrial concentration. This may also require construction of new sewers for industrial waste. These plants would use physical-chemical treatment processes appropriate to the nature of the wastes; and
- Construct and operate a specialized municipal facility for disposal of industrial sludge. This would encourage industries to build their own treatment and pretreatment facilities, and assure that the concentrated wastes from these facilities would receive proper disposal.

These alternatives must be weighed against the implementation of a UC/ICR system. The user charge is designed to recover treatment expenses while the industrial cost recovery is a program for regaining the capital costs of constructing the industrial treatment facilities. Industries will be charged fees in proportion to the costs of treating their wastes.

Table 5.1-A

Summary of Possible Alternatives for Treatment of Combined Sewer Overflows

| Alternative | Description | Advantages/Disadvantages | Land Req'd (acres) for 50 mgd | Present Worth (Millions) |
|---|---|---|---|---|
| Wastewater Concentrator/ Disinfection | Centrifuge type device concentrates sewage. | Compact, simple; only moderate removals. | 0.73 | $ 0.853 |
| Gravity Sedimentation/ Disinfection | Clarifier settles solids. | Simple; only moderate removals. | 2.4 | $ 2.500 |
| Screening/Grit Removal/ Disinfection | Flow passes through a coarse screen. | Compact, simple; only moderate removals. | 0.72 | $ 1.930 |
| Screening/High Rate Filtration | Screen and filter combination. | 40% $BOD_5$ removal, more than 90% SS removal, and 40-70% P removal. | 0.86 | $ 5.220 |
| Sedimentation/Filtration/ Adsorption | Similar to physical-chemical treatment with activated carbon adsorption. | Effluent better than secondary treatment. Requires sophisticated operation skills. | 5.5 | $13.900 |
| Coagulation/Sedimentation. | Similar to physical-chemical treatment. Flocculants are added to aid coagulation. | Effluent comparable to secondary treatment, 80-90 % solids removal. | 3.4 | $11.700 |
| Screening/Dissolved Air Flotation | Air bubbles lift the solids. | Effluent comparable to secondary treatment. | 1.5 | $ 5.850 |
| Contact Stabilization | Variation of activiated sludge process. | Provides secondary treatment. Must be located close to an activiated sludge plant for startups. | 6.9 | $ 9.260 |

## 5.2 Screening of Collection and Treatment Systems

This section presents eleven collection and treatment system alternatives which were organized from the components discussed in Section 5.1. Seven alternative systems for the West Arm are discussed separately. The alternatives have been grouped by similar type, for example, all of the no action alternatives are discussed together. Following the presentation of each group of alternatives, there is an initial screening process to choose the feasible alternatives from the group. The screening is based on major engineering aspects, costs, and human and natural environmental impacts and will not be as detailed as the evaluation of alternatives in Section 5.3. Those alternatives which exhibit major unacceptable environmental impacts, significant problems with implementation or extremely high cost on a comparative basis, are identified and dismissed from further consideration. The remaining feasible alternatives are carried into the intensive evaluation phase.

### 5.2.1 Basic Information about Collection and Treatment Systems

Collection and treatment systems are presented in this section as units for screening and evaluation. Only one collection system alternative meets the objectives of this project and will be included with each treatment system alternative. This collection system includes:

- Conveyance of at least 1050 mgd (3,974,250 $m^3/d$) peak dry weather flow in the year 2000, excluding the Pontiac and Warren systems; and
- Improvements to convey the runoff from a 10-year storm away from the populated areas.

Interceptor locations for various system alternatives are determined by treatment plant location sites.

Policies of retrenchment, status quo, and continued expansion in scope of service and quality by DWSD are considered. The basic alternative plans are No Action Systems (A alternatives), systems for Optimization of Existing Facilities (B alternatives), systems for Major Additions to Existing Facilities (C alternatives), and Unconventional Systems (D alternatives). Several subalternatives are considered in each category. Each alternative system is formulated so that it will provide, to the extent possible, for:

- Wastewater service to the entire study area by DWSD and/or other entities;
- Continued operation of suburban wastewater treatment plants, such as Pontiac and Warren (total 80 mgd or 302,800 $m^3/d$);

- At least secondary or equivalent treatment of 1050 mgd (3,974,250 $m^3/d$) to meet the discharge criteria of 30 mg/l BOD and 30 mg/l SS or 85% removal of same; and
- Total phosphorus reduction in effluent to 1 mg/l.

Managing entities are noted for each alternative. It has been assumed that DWSD, in most cases, would be that entity, although DWSD may not necessarily be in the same institutional form as it now is.

### 5.2.1.1 No Action Alternatives

The no action alternatives are based on either a retrenchment or status quo service policy, i.e. the extent of wastewater services provided by DWSD as a managing entity varies. The "no action" phase implies no change or upgrading in the operational procedures of the DWWTP considering the present conditions of operation and management.

The three subalternatives vary in the location and capacities of additional treatment plants in the study area and the extent of further construction at the DWWTP on Jefferson Avenue. Interceptor sizes and locations would vary with treatment plant locations.

- Reduction of Wastewater Service by DWSD - Alternative A1

This alternative describes the conditions and effects of at least a partial withdrawal by DWSD from its position as operator of the regional wastewater treatment system. Under this alternative, it will be necessary for entities other than DWSD to construct wastewater facilities to provide service to the year 2000.

The DWWTP would continue its present operational procedures, and facilities under construction or under contract would be completed. This would allow for a total capacity of 735 mgd (2,781,975 $m^3/d$) secondary treatment at the DWWTP.

Four suburban treatment plants have been proposed to provide an additional capacity of 500 mgd (1,665,400 $m^3/d$). All the treatment plants with outfalls on the Clinton River or its tributaries would receive tertiary treatment. The Clinton River and Red Run plants would each require 75 acres (30 ha) for their construction sites.

The Metro Airport treatment plant would extend a pipe to the Detroit River for its effluent outfall. A major sewer line with a force main and two pumping stations would be constructed to convey sewage to the new plant from the western suburbs. The acreage required for this plant is 90 acres (36 ha).

The Pointe Mouillee plant, located on the Huron River, would have its outfall on the Detroit River. This plant would require 60 acres (24 ha).

The treatment, facilities, and capacities necessary in the year 2000 for this alternative are listed on Table 5.2-A. Figure 5.2-A shows the location of the treatment facilities.

Costs for Alternative A1 are shown in Table 5.2-B.

- Additional Treatment Outside Detroit by Others Do Nothing by DWSD - Alternative A2a

This alternative is similar to A1 in the extent of service supplied by DWSD. It differs in the configuration of treatment plants to be constructed by outside agencies. Proposed sites at Red Run, Metro Airport, and Pointe Mouillee have different capacities from those in Alternative A1 and have acreage requirements of 85, 90, and 60 acres respectively. The total secondary capacity of the new treatment plants is 105 mgd (397, 425 $m^3/d$) less than the secondary capacity of Alternative A1 but within the original treatment objectives.

In addition to the construction outlined in A1, mandated but presently non-contracted construction at the DWWTP will be done. These modifications will result in additional primary capacity at the main plant of 210 mgd (794,850 $m^3/d$) over present. The total secondary capacity remains at 735 mgd (2,781,975 $m^3/d$) (Table 5.2-C and Figure 5.2-B). Costs for Alternative A2a are shown in Table 5.2-D.

- Additional Treatment in Detroit by Other Entities Do Nothing by DWSD - Alternative A2b

This alternative is identical to Alternative A2a in terms of future DWSD service area and construction to be done at the existing plant. A single additional plant at Connors Creek of 315 mgd (1,192,275 $m^3/d$) is proposed which would require 140 acres (57 ha). Because of its outfall to the Detroit River, advanced wastewater treatment is not considered necessary for these new treatment facilities.

This alternative includes eighteen small stormwater treatment plants along the River Rouge and the Detroit River within the City of Detroit. These are designed to provide preliminary treatment (screening, grit removal, and disinfection) for combined sewer overflows. Following preliminary treatment, the effluent would be discharged to the Detroit River and River Rouge, respectively.

A force main and a new sewer in one barrel of the existing Connors Creek will be included in the collection system for the Conners Creek plant.

The Romeo, Armada, and Richmond Arms, along with the 15 Mile Relief and the Clintondale pumping stations are other collection system additions in this alternative.

Table 5.2-E and Figure 5.2-C show facilities and interceptor locations and capacities. Costs for this alternative are presented in Table 5.2-F.

- Evaluation of No Action Alternatives

In all of the no action alternatives, the effluent from the regional plant would have a long-term adverse impact on surface water quality. EPA has determined that the effluent from the suboptimal operation of the DWWTP would not meet discharge criteria and would result in continued degradation of the Detroit River. Therefore, the DWWTP would not be in compliance with the intent of PL 92-500. This situation would make the no action alternatives unfeasible.

Alternatives A1 and A2a would provide advanced wastewater treatment to 260-270 mgd (984,100 - 1,021,950 $m^3/d$) on the Clinton River or its tributaries. An eventual improvement in the Clinton River water quality would be anticipated.

Secondary effluent from the proposed Conners Creek treatment plant (A2b) will empty into the Detroit River. This is expected to be a long-term adverse impact to water quality although the Detroit River has a high assimilative capacity.

All the alternatives have land requirements for additional treatment plant sites. This is an irretrievable commitment because this land will not be available for any other land use. Alternative A2b would have a lesser impact than A1 or A2a because only one additional treatment plant is proposed.

All the alternatives will have short-term adverse impacts from construction. Alternative A2b will have less severe construction impacts than the other alternatives because only one treatment plant is scheduled for construction.

## Table 5.2-A

## Treatment Facilities and Capacities for Alternative A1 - Reduction of Wastewater Service by DWSD

| Managing Entity | Facility | (Year 2000) Effective Capacity (mgd)* Preliminary | Primary | Secondary | Advanced |
|---|---|---|---|---|---|
| DWSD | Existing Plant | 790 | 630 | 315 | - |
| DWSD | Under Construction | - | - | 420 | - |
| Suburban Existing: | | | | | |
| | Pontiac, Warren | 80 | 80 | 80 | 80 |
| Suburban Proposed: | | | | | |
| | Pointe Mouille | 80 | 80 | 80 | - |
| | Metro Airport | 150 | 150 | 150 | - |
| | Clinton River | 95 | 95 | 95 | 95 |
| | Red Run | 95 | 95 | 95 | 95 |
| | | 1290 | 1130 | 1235 | 270 |

* 1.0 mgd = 3785.0 $m^3/d$

## Table 5.2-B

## Alternative A1 - Monetary Cost Analysis - Million Dollars

| Facilities | Construction | Operation & Maintenance | Present Worth |
|---|---|---|---|
| Existing Plant | - | 23.2 | 289 |
| Pointe Mouille + | 67 | 2.1 | 84 |
| Metro Airport + | 134 | 4.8 | 198 |
| Clinton River | 75 | 3.8 | 110 |
| Red Run | 75 | 3.8 | 110 |
| Collection System | 92 | 5.0 | 141 |
| Overflow Control | 1100 | 4.0 | 1065 |
| Total | 1551 | 46.7 | 1997 |

+ Includes cost of pumping stations and transmission lines

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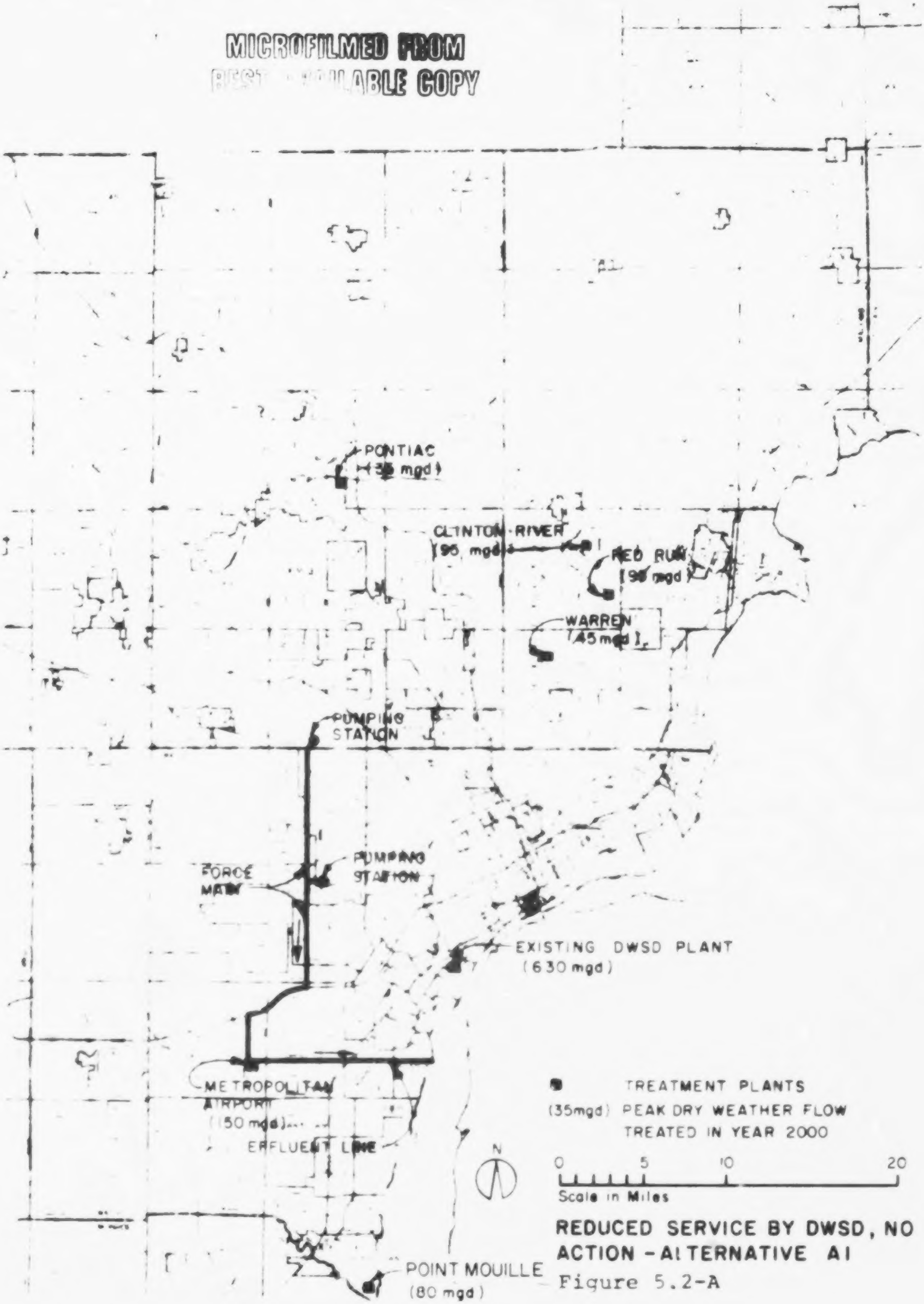

PONTIAC
(35 mgd)
CLINTON RIVER
(95 mgd)
RED RUN
(90 mgd)
WARREN
(45 mgd)
PUMPING STATION
FORCE MAIN
PUMPING STATION
EXISTING DWSD PLANT
(630 mgd)
METROPOLITAN AIRPORT
(150 mgd)
EFFLUENT LINE
POINT MOUILLE
(80 mgd)
■ TREATMENT PLANTS
(35mgd) PEAK DRY WEATHER FLOW TREATED IN YEAR 2000
N
0 5 10 20
Scale in Miles

REDUCED SERVICE BY DWSD, NO ACTION - ALTERNATIVE A1

Figure 5.2-A

## Table 5.2-C

### Treatment Facilities and Capacities for Alternative A2a - Additional Treatment Outside Detroit, No Action, Do Nothing

| Managing Entity | Facility | (Year 2000) Effective Capacity (mgd)* Preliminary | Primary | Secondary | Advanced |
|---|---|---|---|---|---|
| DWSD | Existing Facilities | 790 | 630 | 315 | - |
| DWSD | Mandated Construction | - | 210 | 420 | - |
| S or R** | Red Run | 180 | 180 | 180 | 180 |
| S or R** | Metro Airport | 85 | 85 | 85 | - |
| S or R** | Pointe Mouille | 50 | 50 | 50 | - |
| Suburban | Pontiac, Warren | 80 | 80 | 80 | 80 |
|  |  | 1185 | 1235 | 1130 | 260 |

* 1.0 mgd = 3785 $m^3/d$

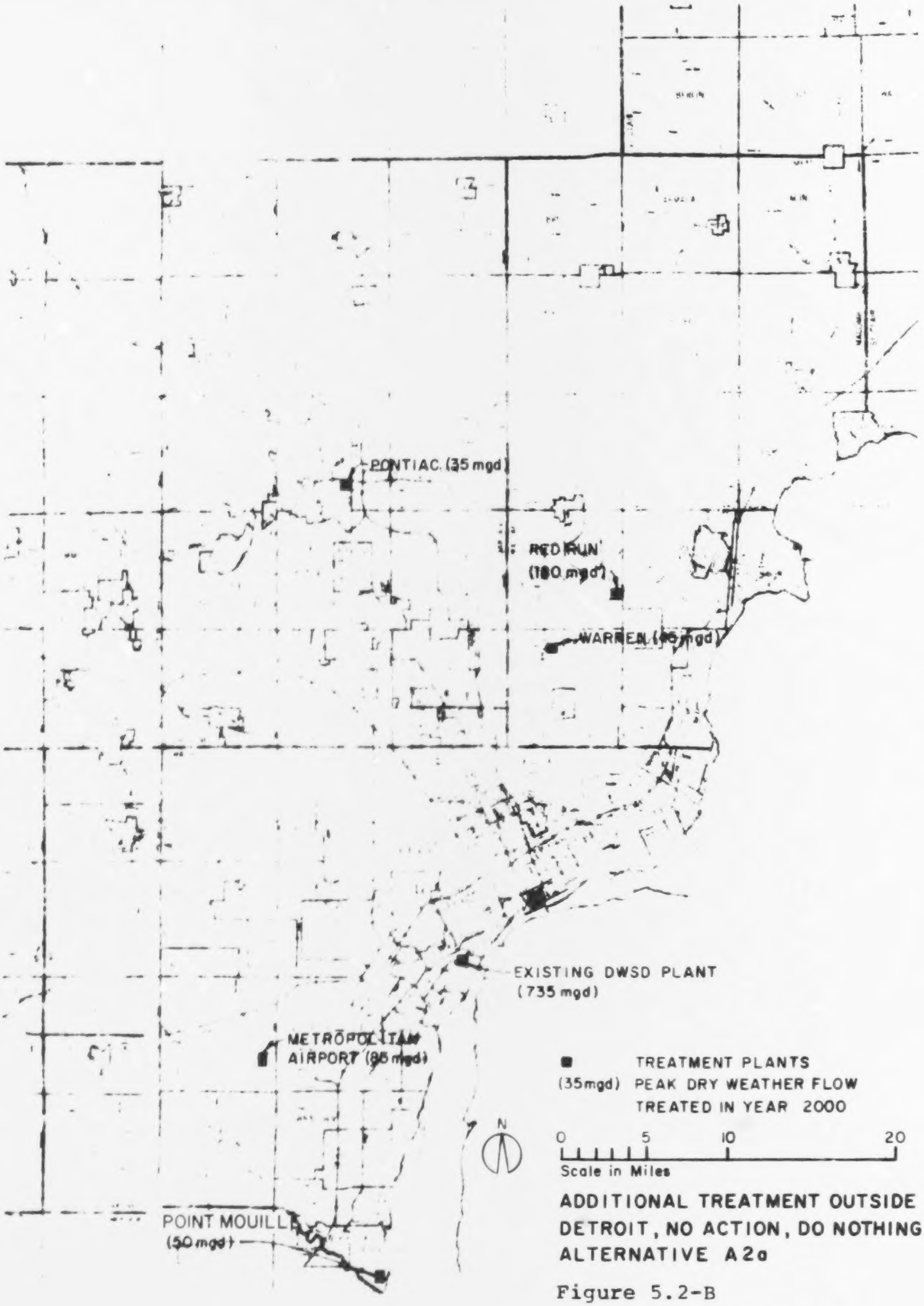
** Suburban or Regional

## Table 5.2-D

### Alternative A2a - Monetary Cost Analysis - Million Dollars

| Facilities | Construction | Operation & Maintenance | Present Worth |
|---|---|---|---|
| Existing Plant | 167 | 27.1 | 529 |
| Red Run | 125 | 6.3 | 184 |
| Metro Airport + | 134 | 4.8 | 198 |
| Collection System | 92 | 5.0 | 141 |
| Overflow Control | 1108 | 4.0 | 1065 |
| Total | 1626 | 47.2 | 2117 |

+ Includes costs of pumping stations and force mains


PONTIAC (35 mgd)
RED RUN (180 mgd)
WARREN (16 mgd)
EXISTING DWSD PLANT (735 mgd)
METROPOLITAN AIRPORT (85 mgd)
POINT MOUILL (50 mgd)
■ TREATMENT PLANTS
(35mgd) PEAK DRY WEATHER FLOW TREATED IN YEAR 2000
N
0
5
10
20
Scale in Miles

ADDITIONAL TREATMENT OUTSIDE DETROIT, NO ACTION, DO NOTHING- ALTERNATIVE A2a

Figure 5.2-B

## Table 5.2-E

### Treatment Facilities and Capacities for Alternative A2b - Additional Treatment in Detroit, Do Nothing by DWSD

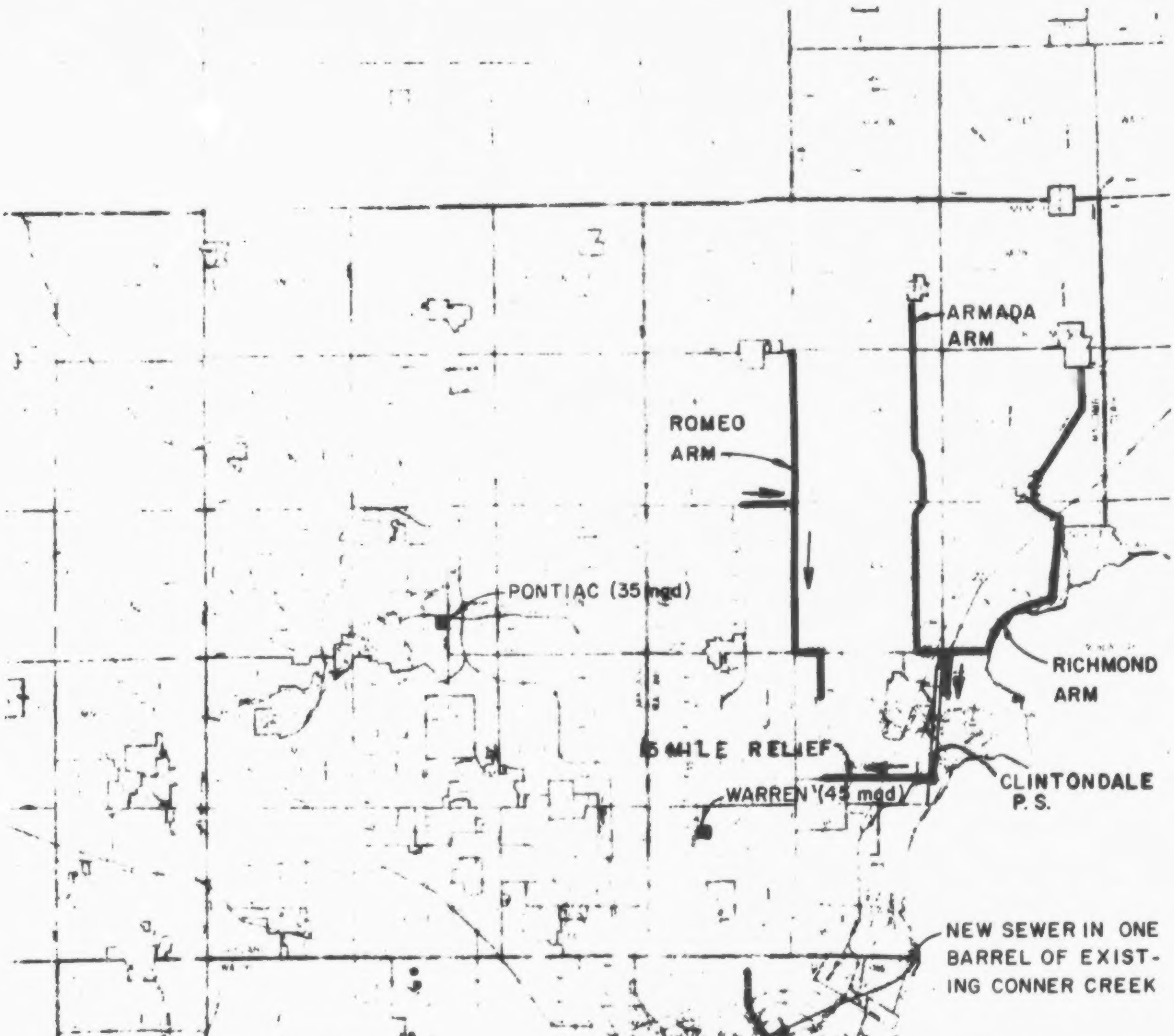
| Managing Entity | Facility | (Year 2000) Effective Capacity (mgd)* Preliminary | Primary | Secondary | Advanced |
|---|---|---|---|---|---|
| DWSD | Existing Facilities | 790 | 630 | 315 | - |
| DWSD | Mandated Construction | - | 210 | 420 | - |
| Regional Entity | Conner Creek Plant | 315 | 315 | 315 | - |
| Suburban | Warren, Pontiac | 80 | 80 | 80 | 80 |
| | | 1185 | 1235 | 1130 | 80 |

* 1.0 mgd=3785.0 $m^3/d$

## Table 5.2-F

### Alternative A2b - Monetary Cost Analysis - Million Dollars

| Facilities | Construction | Operation & Maintenance | Present Worth |
|---|---|---|---|
| Existing Plant | 167 | 27.1 | 529 |
| Conner Creek | 163 | 9.1 | 250 |
| Collection System | 102 | 5.0 | 150 |
| Overflow Control | 1108 | 4.0 | 1065 |
| Total | 1540 | 45.2 | 1994 |


ARMADA ARM
ROMEO ARM
PONTIAC (35 mgd)
RICHMOND ARM
15 MILE RELIEF
WARREN (45 mgd)
CLINTONDALE P.S.
NEW SEWER IN ONE BARREL OF EXISTING CONNER CREEK
STORMWATER TREATMENT PLANT, (TYP.)
CONNER FORCE MAIN
CONNER CREEK (315 mgd)
EXISTING DWSD PLANT (735 mgd)
PROPOSED INTERCEPTORS
STORM WATER T.P.
TREATMENT PLANTS
(35mgd) PEAK DRY WEATHER FLOW TREATED IN YEAR 2000
N
0
5
10
20
Scale in Miles

ADDITIONAL TREATMENT IN DETROIT, NO NOTHING BY DWSD - ALTERNATIVE A2b

Figure 5.2-C

In summary, A2b would be the least environmentally damaging because it has the least irretrievable loss of land and the least amount of construction related impacts. The majority of the impacts of the alternatives are similar, but water quality impacts cannot be compared among the alternatives.

The NEPA requires that a no action alternative be evaluated with the other feasible alternatives. Therefore, Alternative A2b will be retained for further analysis. This system was chosen because (1) it is the lowest in cost, (2) the single new treatment plant site at Conners Creek is most compatible with the existing collection systems, and (3) it is the least environmentally damaging choice. Alternatives A1 and A2a will not be given further consideration.

#### 5.2.1.2 Systems for Optimization of Existing Facilities

Two options were presented by the applicant under this major alternative: (1) optimum operation of the installed and mandated equipment, and (2) optimization of design capacity which includes optimum operation plus construction required to bring the plant up to design capabilities (Giffels/Black and Veatch, 1977, Book I). Under both options, DWSD would continue to provide wastewater management for the present service area, expand the area serviced, and accommodate future flows from contracted areas.

- Optimum Operation of Existing and Mandated Facilities - Alternative B1

Alternative B1 proposes that DWSD: (1) complete construction mandated by EPA, (2) improve management, operation and maintenance practices, (3) provide minimum structural improvements, and (4) provide wastewater service in the planning area through the year 2000.

When mandated construction is completed at the existing plant and operation is improved, the plant capacity will increase to 840 mgd (3,179,000 $m^3$/d). An additional plant with a capacity of 210 mgd (794,850 $m^3$/d) would be constructed immediately on property north of the existing plant and would provide secondary treatment. This treatment plant site would require 60 acres (24 ha).

The proposed Romeo, Armada and Richmond interceptor arms and the Clintondale pumping station will extend the collection service north of the City of Detroit. The treatment facilities and capacities necessary in the year 2000 for this alternative are listed on Table 5.2-G (Giffels/Black and Veatch, 1977, Book XII). Costs are shown in Table 5.2-H. Figure 5.2-D shows the location of the treatment facilities and collection system improvements.

- Optimization at Design Capacity - Alternative B2

Alternative B2 is the same as Alternative B1 except that certain facilities would be rehabilitated at the existing plant to achieve a balanced capacity in all process units and bring the plant to its design capacity of 1050 mgd (3,974,250 $m^3/d$) (Giffels/Black and Veatch, 1977, Book I). This renovation would involve the following facilities and/or processes: grit removal, chemical feed, final clarifiers, chlorinating system, primary sludge pump, vacuum filtration system, and incineration.

This alternative would require the purchase of 48 acres (19 ha) adjacent to the existing site. Construction would include a 50 mgd (189,000 $m^3/d$) secondary treatment plant, appurtenances, and a pumping station to force the final effluent to the existing outfall. This plant may not be required until late in the study period (1995) but acquisition of the land could commence well in advance to minimize the disruption of relocating the residents.

Collection system additions include construction of the Romeo, Armada, and Richmond interceptor arms and the Clintondale pumping station which will provide an extension of service into Macomb County. Eighteen stormwater treatment plants will be built along the River Rouge and the Detroit River within the City of Detroit. These are covered basins designed to provide preliminary treatment (screening, grit removal, and disinfection) for combined sewer overflows. Following preliminary treatment, the effluent would be discharged to the Detroit River and River Rouge, respectively.

Table 5.2-I lists the treatment facilities and capacities necessary for this alternative in the year 2000. Costs are shown in Table 5.2-J and the location of the facilities and collection system improvements are shown in Figure 5.2-E.

A detailed descriptive summary of facility and collection system requirements for Alternative B2 is given in the SFP.

- Evaluation of Optimization Alternatives

Alternatives B1 and B2 would provide adequate treatment to meet discharge requirements. Impacts to surface water quality in the Detroit River would be similar under both alternatives.

Land requirements for Alternative B2 are less because of the smaller size of the new plant and land acquisition is spread over a longer period of time than for Alternative B1. Disruption to residents who must be relocated will

## Table 5.2-G

## Treatment Facilities and Capacities for Alternative Bl - Optimum Operation of Existing and Mandated Facilities

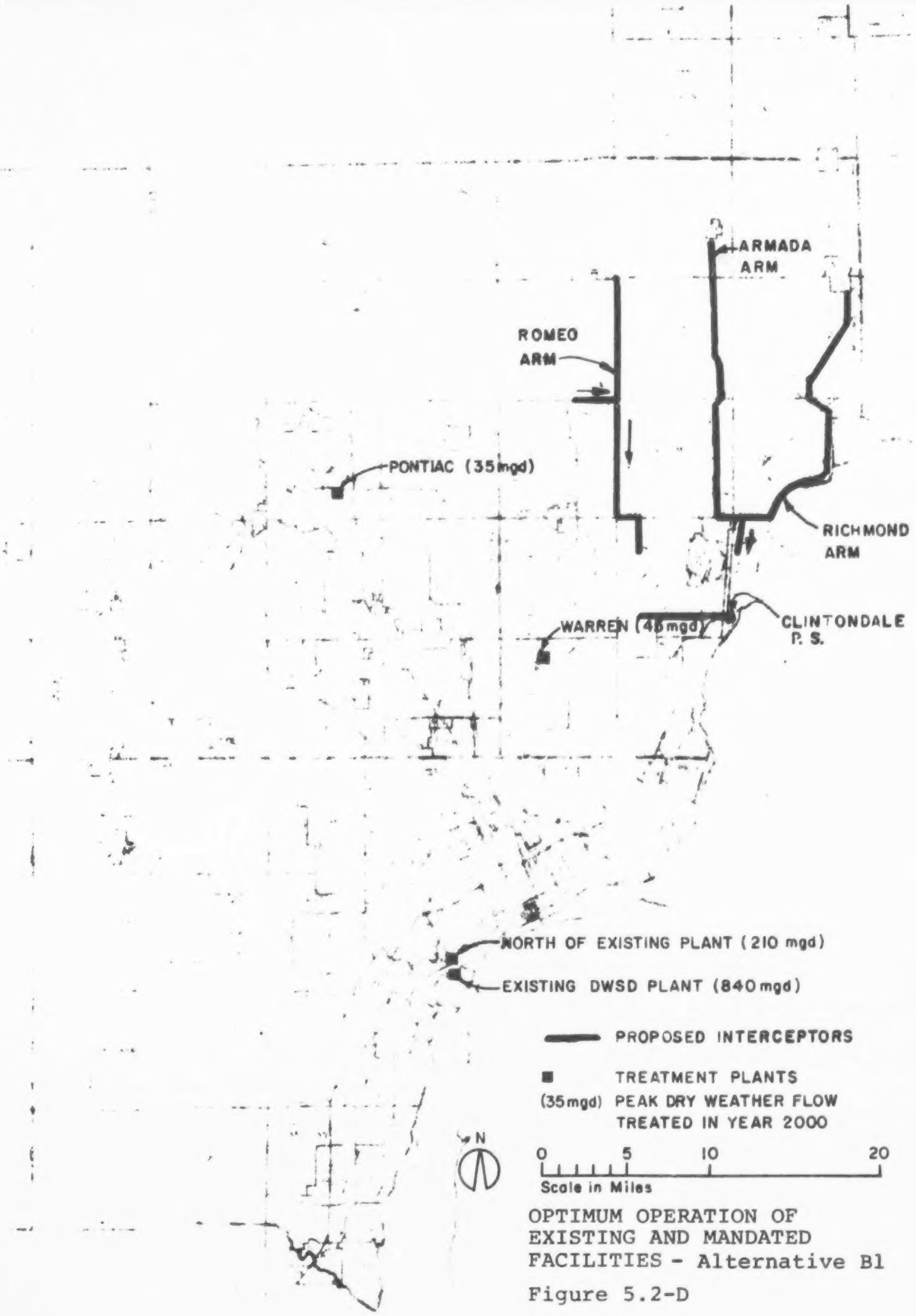
| Managing Entity | Facility | (Year 2000) Effective Capacity (mgd)* Preliminary | Primary | Secondary | Advanced |
|---|---|---|---|---|---|
| DWSD | Existing Plant | 895 | 630 | 315 | - |
| DWSD | Mandated Construction | - | 210 | 420 | - |
| DWSD | Improved Operation | - | 120 | 105 | - |
| DWSD | North of Existing Plant | 210 | 210 | 210 | - |
| Suburban | Pontiac, Warren | 80 | 80 | 80 | 80 |
| | | 1185 | 1250 | 1130 | 80 |

* 1.0 mgd = 3785.0 $m^3/d$

## Table 5.2-H

## Alternative Bl - Monetary Cost Analysis - Million Dollars

| Facilities | Construction | Operation & Maintenance | Present Worth |
|---|---|---|---|
| Existing Plant | 203 | 31.0 | 610 |
| North of Existing Plant | 124 | 6.3 | 182 |
| Collection System | 92 | 5.0 | 141 |
| Overflow | 1108 | 4.0 | 1065 |
| Total | 1527 | 46.3 | 1998 |


ARMADA ARM
ROMEO ARM
PONTIAC (35mgd)
RICHMOND ARM
WARREN (46mgd)
CLINTONDALE P. S.
NORTH OF EXISTING PLANT (210 mgd)
EXISTING DWSD PLANT (840 mgd)
PROPOSED INTERCEPTORS
■ TREATMENT PLANTS
(35mgd) PEAK DRY WEATHER FLOW TREATED IN YEAR 2000
N
0
5
10
20
Scale in Miles

OPTIMUM OPERATION OF EXISTING AND MANDATED FACILITIES - Alternative B1

Figure 5.2-D

## Table 5.2-I

## Treatment Facilities and Capacities for Alternative B2 - Optimization at Design Capacity

| Managing Entity | Facility | (Year 2000) Effective Capacity (mgd)* Preliminary | Primary | Secondary | Advanced |
|---|---|---|---|---|---|
| DWSD | Existing Facilities | 895 | 630 | 315 | - |
| DWSD | Mandated Construction | - | 210 | 420 | - |
| DWSD | Improved Operation | - | 120 | 105 | - |
| DWSD | Renovation and Optimization | 210 | 120 | 160 | - |
| Suburban | Pontiac, Warren | 80 | 80 | 80 | 80 |
| DWSD | Additional Plant + | - | 50 | 50 | - |
| | | 1185 | 1210 | 1130 | 80 |

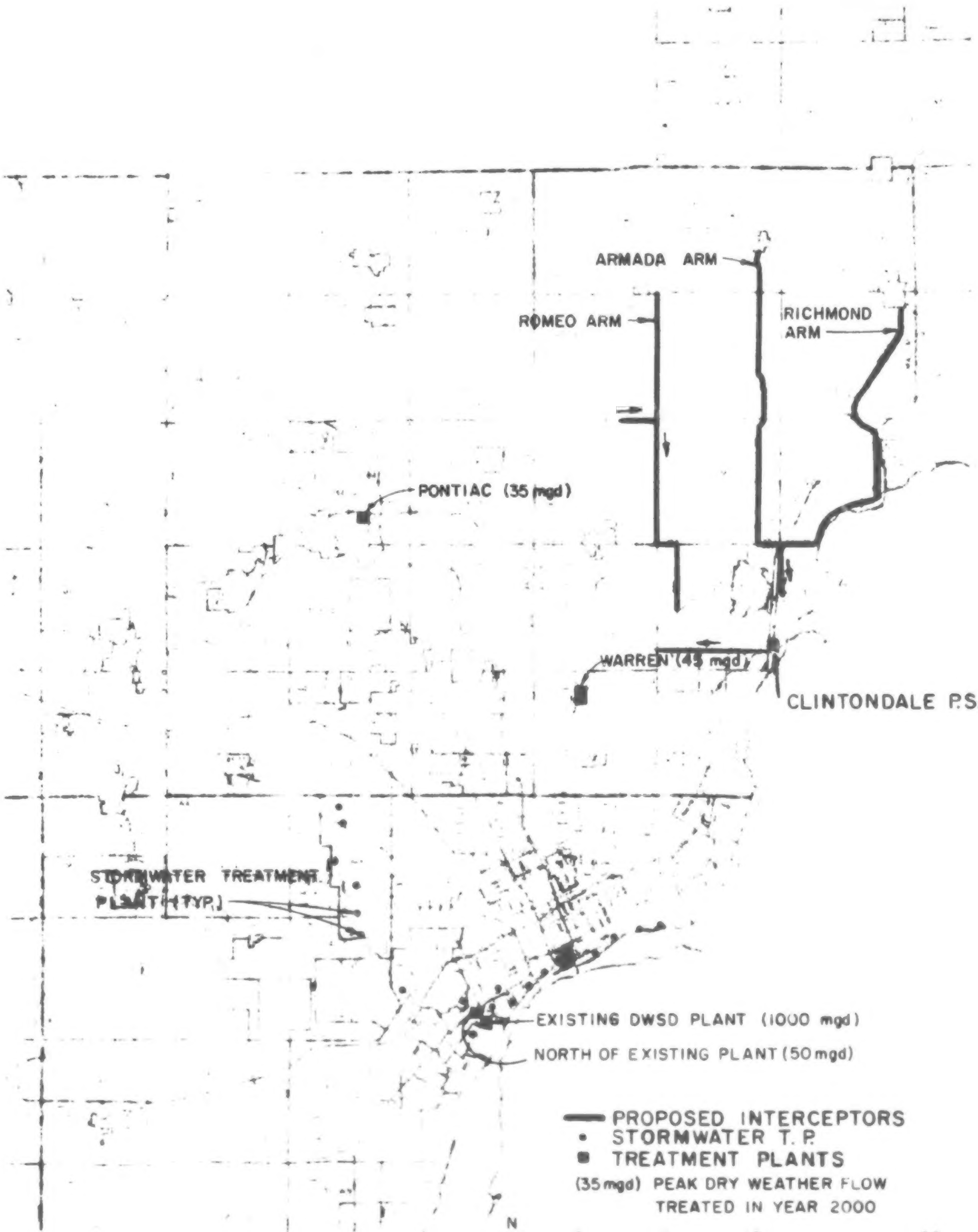
* 1.0 mgd= 3785.0 $m^3/d$

## Table 5.2-J

## Alternative B2 - Monetary Cost Analysis - Million Dollars

| Facilities | Construction | Operation & Maintenance | Present Worth |
|---|---|---|---|
| Existing Plant | 243 | 31.0 | 649 |
| Additional Plant + | 39 | 2.1 | 9* |
| Collection System | 147 | 6.0 | 203 |
| Overflow Control | 1108 | 4.0 | 1065 |
| Total | 1537 | 43.1 | 1926 |

+ Additional 50 mgd Plant constructed in 1995 is an integral part of the major additions to existing plant.


ARMADA ARM
ROMEO ARM
RICHMOND ARM
PONTIAC (35 mgd)
WARREN (45 mgd)
CLINTONDALE P.S.
STORMWATER TREATMENT PLANT (TYP.)
EXISTING DWSD PLANT (1000 mgd)
NORTH OF EXISTING PLANT (50 mgd)
PROPOSED INTERCEPTORS
● STORMWATER T.P.
■ TREATMENT PLANTS
(35mgd) PEAK DRY WEATHER FLOW TREATED IN YEAR 2000
N
0
5
10
20
Scale in Miles

OPTIMIZATION AT
DESIGN CAPACITY - Alternative B2

Figure 5.2-E

be less under the B2 Alternative. Construction impacts to air, land, and water quality would be less severe under Alternative B2. Long term impacts to surface water quality would be similar under both alternatives.

Alternative B2 is the more feasible alternative because it is (1) less costly, and (2) there will be fewer construction impacts and neighborhood disruptions than in Alternative B1. Therefore, B2 will be given further consideration and B1 will be dropped from further consideration.

### 5.2.1.3 Major Additions to Existing Systems Alternatives

Three subalternatives are presented in this section. One option adds a treatment plant at Conners Creek to supplement the suboptimal operation of the regional plant. The other two options add major process units to an optimized regional plant. These two subalternatives would also have new pumping stations of different capacities that would greatly increase preliminary capacity.

DWSD would continue as the managing entity for the present wastewater service area.

- Dispersed Treatment by DWSD - Alternative C1

Alternative C1 is identical to Alternative A2b except that DWSD or some other entity would be the sole manager (see Section 5.1 Institutional of this document) of all facilities in the study area.

This alternative would involve:

- Acquisition of 140 acres (57 ha) at Conners Creek and construction of a secondary treatment plant with capacity of 315 mgd (1,192,275 $m^3/d$);
- Completion of mandated construction at the regional plant bringing it up to a secondary capacity of 735 mgd (2,781,975 $m^3/d$);
- Less than full utilization of equipment at DWWTP but no further construction at that site;
- Eighteen stormwater treatment plants along the River Rouge and the Detroit River within the City of Detroit that would give preliminary treatment (screening, grit removal, and disinfection) for CSO;
- A force main and a new sewer in one barrel of the existing Conners Creek would be included in the collection system for the Conners Creek plant; and
- General collection system additions including the Romeo, Armada, and Richmond interceptor arms, the 15 Mile Relief, and the Clintondale pumping station.

With this treatment alternative, Sludge Complex III would be omitted from the regional plant and a residuals disposal alternative would be necessary at the Conners Creek plant.

Treatment facilities and capacities for the year 2000 for Alternative C1 are presented in Table 5.2-K. Figure 5.2-F shows the location of the treatment facilities and collection system additions. Costs are shown in Table 5.2-L.

- Additions to Optimized Plant, 2435 mgd
  Preliminary Capacity - Alternative C2a

Alternative C2a considered the major option of a new pumping station acting together with the existing but rehabilitated pumping station. This would provide a total preliminary treatment capacity of 2435 mgd (9,216,475 $m^3/d$). A network of nineteen stormwater retention basins along the River Rouge and Detroit River would hold combined sewer overflow and dewater it at a rate that the pumping station could convey it to the main plant. These underground basins differ from stormwater treatment plants in that no treatment occurs until the wastewater has been transferred to DWWTP. It then receives preliminary treatment and is discharged to the Detroit River.

In addition to the construction of mandated facilities, (see Chapter 1.0 of this document) and upgrading required for optimum design capacity operations, the following were recommended modifications under this alternative:

- New pumping station of 1200 mgd (4,542,000 $m^3/d$) firm capacity;
- New coarse and fine screens;
- New aerated grit chambers;
- New chemical building for phosphorus removal chemicals;
- New mixing and flocculation facilities;
- Flow measurement;
- Replacement of the existing rectangular clarifiers with new clarifiers;
- New chlorination facilities; and
- Additional gravity thickeners, blending and storage facilities.

An additional 50 mgd (189,250 $m^3/d$) treatment plant requiring 48 acres (19 ha), would be constructed north of the existing plant. This construction and its associated costs are considered an integral part of the major additions to the existing plant.

Proposed collection system additions in the Macomb District include the Romeo, Armada, and Richmond interceptor arms, the 15 Mile Relief Sewer and the Clintondale pumping station.

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## Table 5.2-K

## Treatment Facilities and Capacities for Alternative C1 - Dispersed Treatment by DWSD

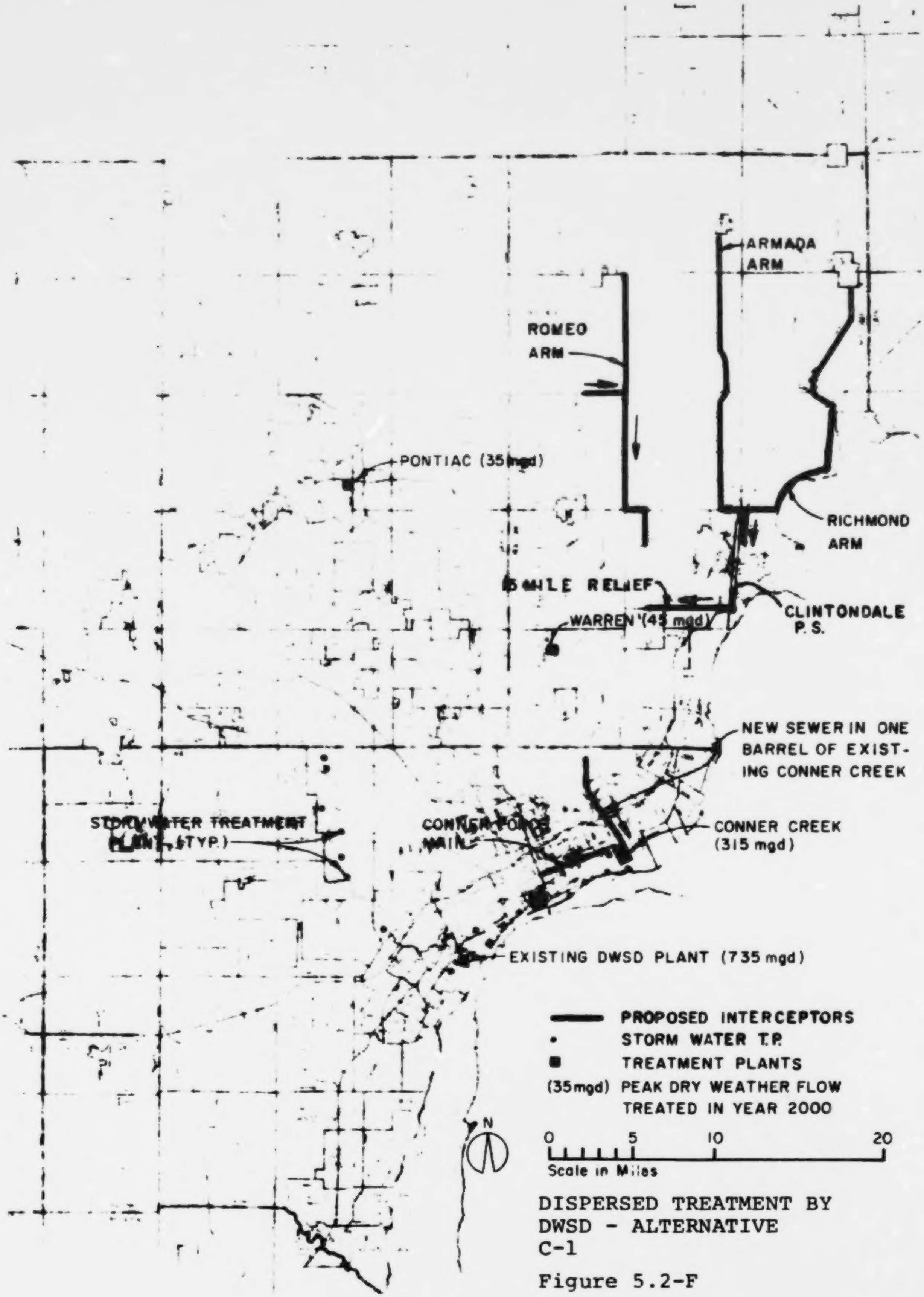
| Managing Entity | Facility | (Year 2000) Effective Capacity (mgd)* Preliminary | Primary | Secondary | Advanced |
|---|---|---|---|---|---|
| DWSD | Existing Facilities | 790 | 630 | 315 | - |
| DWSD | Mandated Construction | - | 210 | 420 | - |
| DWSD | Conner Creek Plant | 315 | 315 | 315 | - |
| Suburban | Warren, Pontiac | 80 | 80 | 80 | 80 |
| | | 1185 | 1235 | 1130 | 80 |

* 1.0 mgd = 3785.0 $m^3/d$

## Table 5.2-L

## Alternative C1 - Monetary Cost Analysis - Million Dollars

| Facilities | Construction | Operation & Maintenance | Present Worth |
|---|---|---|---|
| Existing Plant | 167 | 27.1 | 529 |
| Conner Creek | 163 | 9.1 | 250 |
| Collection System | 102 | 5.0 | 150 |
| Overflow Control | 1108 | 4.0 | 1065 |
| Total | 1540 | 45.2 | 1994 |


ARMADA ARM
ROMEO ARM
PONTIAC (35 mgd)
RICHMOND ARM
15 MILE RELIEF
WARREN (45 mgd)
CLINTONDALE P.S.
NEW SEWER IN ONE BARREL OF EXISTING CONNER CREEK
STORM WATER TREATMENT PLANT (TYP.)
CONNER FORCE MAIN
CONNER CREEK (315 mgd)
EXISTING DWSD PLANT (735 mgd)
PROPOSED INTERCEPTORS
• STORM WATER T.P.
■ TREATMENT PLANTS
(35mgd) PEAK DRY WEATHER FLOW TREATED IN YEAR 2000
0
5
10
20
Scale in Miles
N

DISPERSED TREATMENT BY
DWSD - ALTERNATIVE
C-1

Figure 5.2-F

The treatment facilities and capacities necessary in the year 2000 for this alternative are listed on Table 5.2-M. Figure 5.2-G shows the location of the treatment facilities and necessary collection system additions. Costs for Alternative C2a are shown in Table 5.2-N.

- Additions to Optimized Plant 2730 mgd Preliminary Capacity - Alternative C2b

As in Alternative C2a, emphasis in this alternative is on the replacement of headworks, primary treatment and chlorination facilities. The major difference between this option and the preceeding one is that the old pumping station is entirely replaced by a new one that has double the capacity of the one proposed in Alternative C2a. Nineteen stormwater retention basins along the River Rouge and Detroit River would temporarily hold CSO until it was pumped to the main plant. After preliminary treatment at DWWTP, the effluent would be pumped into the Detroit River.

In addition to the construction of mandated facilities (see Chapter 1.0 of this document) and upgrading required for optimum operation, i.e. a design capacity of 1050 mgd (3,974,250 $m^3$/d), the following were recommended modifications under this alternative:

- New pumping station of 2400 mgd (8,364,000 $m^3$/d) firm capacity;
- New coarse and fine screens;
- New aerated grit chambers;
- New chemical building for phosphorus removal chemicals;
- New mixing and flocculation facilities;
- Flow measurement;
- Replacement of the existing rectangular clarifiers with new clarifiers;
- New chlorination facilities; and
- Additional gravity thickeners, blending and storage facilities.

An additional 50 mgd (189,250 $m^3$/d) treatment plant, requiring 48 acres (19 ha) would be constructed north of the existing plant. This construction and its associated costs are considered an integral part of the major additions to the existing plant.

Proposed collection system additions in the Macomb District include the Romeo, Armada, and Richmond interceptor arms, the 15 Mile Relief Sewer, and the Clintondale pumping station.

The treatment facilities and capacities necessary in the year 2000 for this alternative are listed on Table 5.2-O and costs are shown in Table 5.2-P. Figure 5.2-H shows locations of facilities and collection system additions.

- Evaluation of Major Additions Alternatives

Alternative C1 is identical to Alternative A2b except for the institutional arrangements, i.e. both the existing plant and the new facility would be controlled by DWSD or at least the same managing entity (see Section 5.7). This alternative, like A2b, is not feasible because effluent from the suboptimal operation of the DWWTP would not comply with the proposed discharge criteria. Surface water quality in the Detroit River would continue to be severely impacted. Alternative C1 will not be given further consideration.

Alternatives C2a and C2b are similar except that the latter provides for increased preliminary treatment capacity and more reliable operation due to the construction of the new 2400 mgd (9,084,000 $m^3/d$) pumping station. C2b would provide greater relief from combined sewage than C2a and lessen the impact to surface water quality from untreated CSO. Treated combined flow would outfall to the Detroit River which has a large dilutional effect. For these reasons, Alternative C2b is considered the more feasible option and will receive further detailed analysis in the evaluation phase. Alternative C2a will not receive further consideration.

### 5.2.1.4 Unconventional Systems Alternatives

This group of alternatives presents diversified methods of achieving the same regional service results as the other alternatives. The three subalternatives include (1) land application of secondary effluent from an additional treatment plant, (2) abandonment of the existing plant and replacement with several other facilities throughout the service area, and (3) a split treatment at the existing plant which would replace the conventional secondary treatment.

DWSD would continue as the managing entity for the present wastewater service area.

- Land Application of Secondary Effluent - Alternative D1

Under this alternative, the existing regional plant would be brought up to optimum operation, as discussed in Alternative B1, with a secondary capacity of 840 mgd (3,179,000 $m^3/d$) and discharge to the Detroit River.

## Table 5.2-M

### Treatment Facilities and Capacities for Alternative C2a - Additions to Optimized Plant, 2435 mgd Preliminary Capacity

| Managing Entity | Facilities | (Year 2000) Treatment Capacity (mgd)* Preliminary | Primary | Secondary | Advanced |
|---|---|---|---|---|---|
| DWSD | Existing Facilities | 895 | 210 | 315 | - |
| DWSD | Mandated Construction | - | 210 | 420 | - |
| DWSD | Improved Operation | - | - | 105 | - |
| DWSD | Renovation | 210 | - | 160 | - |
| DWSD | New Facilities | 1200 | 630 | - | - |
| Suburban | Pontiac, Warren | 80 | 80 | 80 | 80 |
| DWSD | Additional Plant + | 50 | 50 | 50 | - |
| | | 2435 | 1180 | 1130 | 80 |

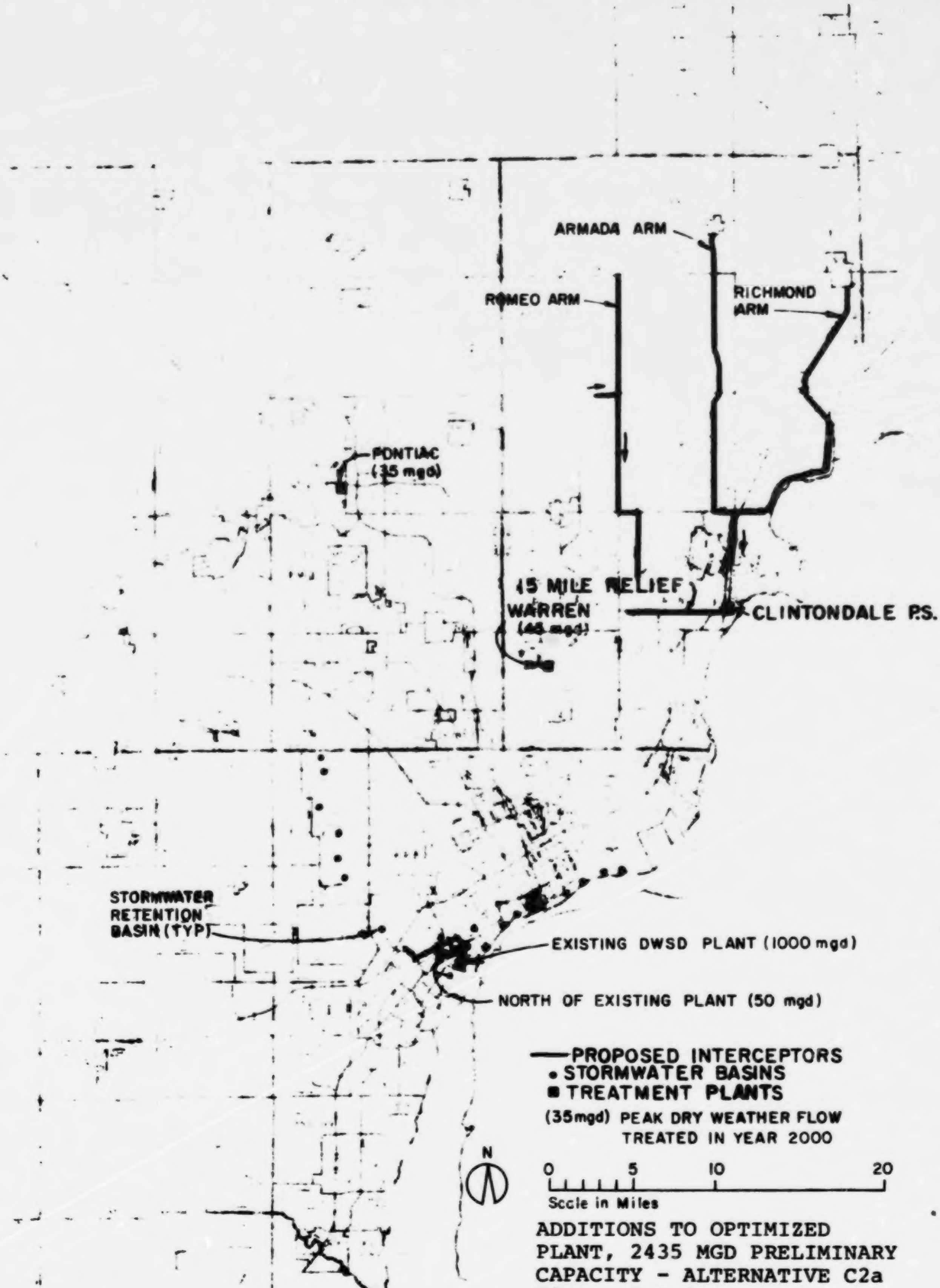
* 1.0 mgd = 3785.0 $m^3/d$

## Table 5.2-N

### Alternative C2a - Monetary Cost Analysis - Million Dollars

| Facilities | Construction | Operation & Maintenance | Present Worth |
|---|---|---|---|
| Existing Plant | 420 | 35.0 | 872 |
| Additional Plant + | * | * | * |
| Collection System | 147 | 6.0 | 203 |
| Overflow Control | 835 | 0.8 | 740 |
| Total | 1402 | 41.8 | 1815 |

+ Additional 50 mgd plant constructed in 1995 is an integral part of the major additions to the existing plant.


ARMADA ARM
ROMEO ARM
RICHMOND ARM
PONTIAC (35 mgd)
15 MILE RELIEF
WARREN (45 mgd)
CLINTONDALE P.S.
STORMWATER RETENTION BASIN (TYP)
EXISTING DWSD PLANT (1000 mgd)
NORTH OF EXISTING PLANT (50 mgd)
— PROPOSED INTERCEPTORS
● STORMWATER BASINS
■ TREATMENT PLANTS
(35mgd) PEAK DRY WEATHER FLOW TREATED IN YEAR 2000
N
0
5
10
20
Scale in Miles

ADDITIONS TO OPTIMIZED PLANT, 2435 MGD PRELIMINARY CAPACITY - ALTERNATIVE C2a
Figure 5.2-G

## Table 5.2-O

## Treatment Facilities and Capacities for Alternative C2b - Additions to Optimized Plant, 2730 mgd Preliminary Capacity

| Managing Entity | Facilities | (Year 2000) Treatment Capacity (mgd)* Preliminary | Primary | Secondary | Advanced |
|---|---|---|---|---|---|
| DWSD | Existing Facilities | - | 210 | 315 | - |
| DWSD | Mandated Construction | - | 210 | 420 | - |
| DWSD | Improved Operation | - | - | 105 | - |
| DWSD | Renovation | - | - | 160 | - |
| DWSD | New Facilities | 2600 | 630 | - | - |
| Suburban | Pontiac, Warren | 80 | 80 | 80 | 80 |
| DWSD | Additional Plant + | 50 | 50 | 50 | - |

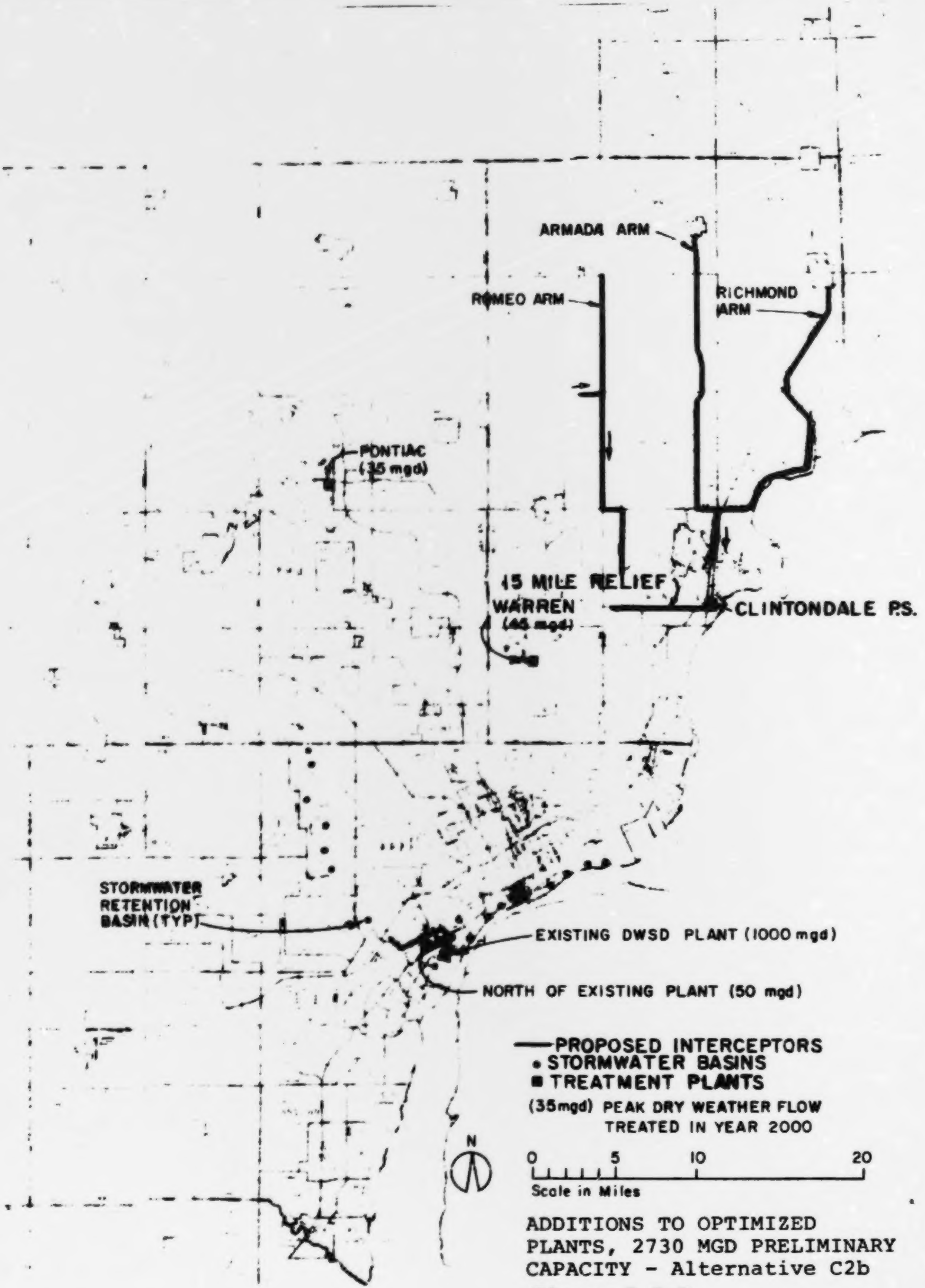
* 1.0 mgd = 3785.0 $m^3/d$

## Table 5.2-P

## Alternative C2b - Monetary Cost Analysis - Million Dollars

| Facilities | Construction | Operation & Maintenance | Present Worth |
|---|---|---|---|
| Existing Plant | 490 | 39.0 | 989 |
| Additional Plant + | * | * | * |
| Collection System | 147 | 6.0 | 203 |
| Overflow System | 835 | 0.8 | 740 |
| Total | 1472 | 45.8 | 1932 |

+ Additional 50 mgd plant constructed in 1995 is an integral part of the major additions to the existing plant.


ARMADA ARM
ROMEO ARM
RICHMOND ARM
PONTIAC (35 mgd)
15 MILE RELIEF
WARREN (46 mgd)
CLINTONDALE P.S.
STORMWATER RETENTION BASIN (TYP)
EXISTING DWSD PLANT (1000 mgd)
NORTH OF EXISTING PLANT (50 mgd)
PROPOSED INTERCEPTORS
• STORMWATER BASINS
■ TREATMENT PLANTS
(35mgd) PEAK DRY WEATHER FLOW TREATED IN YEAR 2000
N
0
5
10
20
Scale in Miles

ADDITIONS TO OPTIMIZED PLANTS, 2730 MGD PRELIMINARY CAPACITY - Alternative C2b
Figure 5.2-H

Sidestreams from the solids handling facilities increase the BOD level. Therefore, additional facilities would be required to continually achieve a 30-30 effluent. A 300 mgd (1,136,000 $m^3/d$) pure $O_2$ activated sludge module would be used for reduction of soluble BOD. The activated sludge effluent would be blended with the primary effluent ahead of filtration and disinfection.

This alternative calls for optimum phosphorus removal facilities, additional primary sedimentation capacity, followed by gravity filtration.

To implement this alternative, the following facilities and provisions would be necessary:

- Construction of the mandated facilities and upgraded operation;
- Construction of the proposed pumping, aerated grit, screening, chemical mixing, and flow measurement facilities for a total of 2600 mgd (9,841,000 $m^3/d$) preliminary treatment at the main plant;
- Provision of the capability to feed 20 mg/l of ferric chloride (as iron);
- Conversion of 12 secondary sedimentation basins to primary units;
- Construction of new 150 square foot (14 $m^2$) primary basins;
- Provision of a filter complex with 132,000 square feet (12,300 $m^2$) of mixes media filter surface area;
- Conversion of four secondary sedimentation basins to backwash storage and chlorine contact basins and provisions of backwash pumping capacity;
- Installation of new clarifiers with 82,000 square feet (7,600 $m^2$) of surface area for backwash reclamation, and reclaimed backwash return pumping;
- Operation of 300 mgd (1,136,000 $m^3/d$) oxygen activated sludge capacity and nine renovated secondary clarifiers (the area currently utilized by the remaining aeration facilities would be occupied by new unit processes);
- Provision of new chlorination facilities;
- Modification of intermediate pumping capability to accommodate use of secondary basins as primaries and continued operation of 300 mgd (1,136,000 $m^3/d$) of secondary capacity;
- Provision of additional sludge handling capability including pumping, thickeners, and vacuum filters; and
- Operation of six circular primary clarifiers - two are currently in operation, two are under construction, and two are scheduled for construction.

Flows above 840 mgd (3,179,000 $m^3$/d) would be accommodated by new treatment facilities at Red Run which would provide secondary treatment and solids disposal facilities for 210 mgd (794,850 $m^3$/d). Approximately 93 acres (38 ha) would be required at the site. Land application of the secondary effluent would be accomplished by transmission and dispersal systems. The land application site would require 45,000 acres (18,212 ha) or 70 sq. mi. (181 $km^2$). For this analysis, a suitable land application site was assumed to be available 30 miles (48 km) from a proposed treatment plant site at Red Run and at such an elevation that only one pump station providing 100 ft. (30 m) of head would be required. It was also assumed that a six-month application period per year would be available and storage lagoons would be constructed on the land application site. Figure 5.2-I represents a hypothetical 72 sq. mi. (186 $km^2$) preserve within the study area, the Red Run treatment plant, and transmission lines. Table 5.2-R shows the costs of this alternative and Table 5.2-Q presents treatment facilities and their capacities.

- Abandon Existing Plant - Alternative D2

This alternative proposes dispersed treatment. Existing facilities would be eliminated and replaced by smaller facilities, 335 mgd (1,267,975 $m^3$/d), just north of the existing site. Five other facilities operated by DWSD would be built at various locations in the study area.

Known land requirements for these new plants are as follows: Clinton River - 75 acres (30 ha), Red Run - 75 acres (30 ha), Conners Creek - 140 acres (57 ha), and north of existing plant - 160 acres (65 ha). All treatment plants constructed on the Clinton River or its tributaries would receive advanced waste treatment. The locations of the proposed plants and collection system additions are shown in Figure 5.2-J. Tables 5.2-S and 5.2-T present treatment capacities and costs for this alternative.

- Split Treatment - Alternative D3

This alternative proposes a split chemical/physical treatment consisting of chemical treatment for phosphorus removal followed by conventional primary sedimentation. (Conventional primary sedimentaiton has low overflow rates in comparison to the type presently employed at Detroit). The resulting primary effluent should approach the quality of secondary effluent because raw wastewater entering DWWTP is fairly low in soluble BOD. Average influent BOD, however, does not consistently fall below the 30 mg/l limit defined by EPA for secondary treatment.

## Table 5.2-Q

## Treatment Facilities and Capacities for Alternative D1 - Land Application of Secondary Effluent

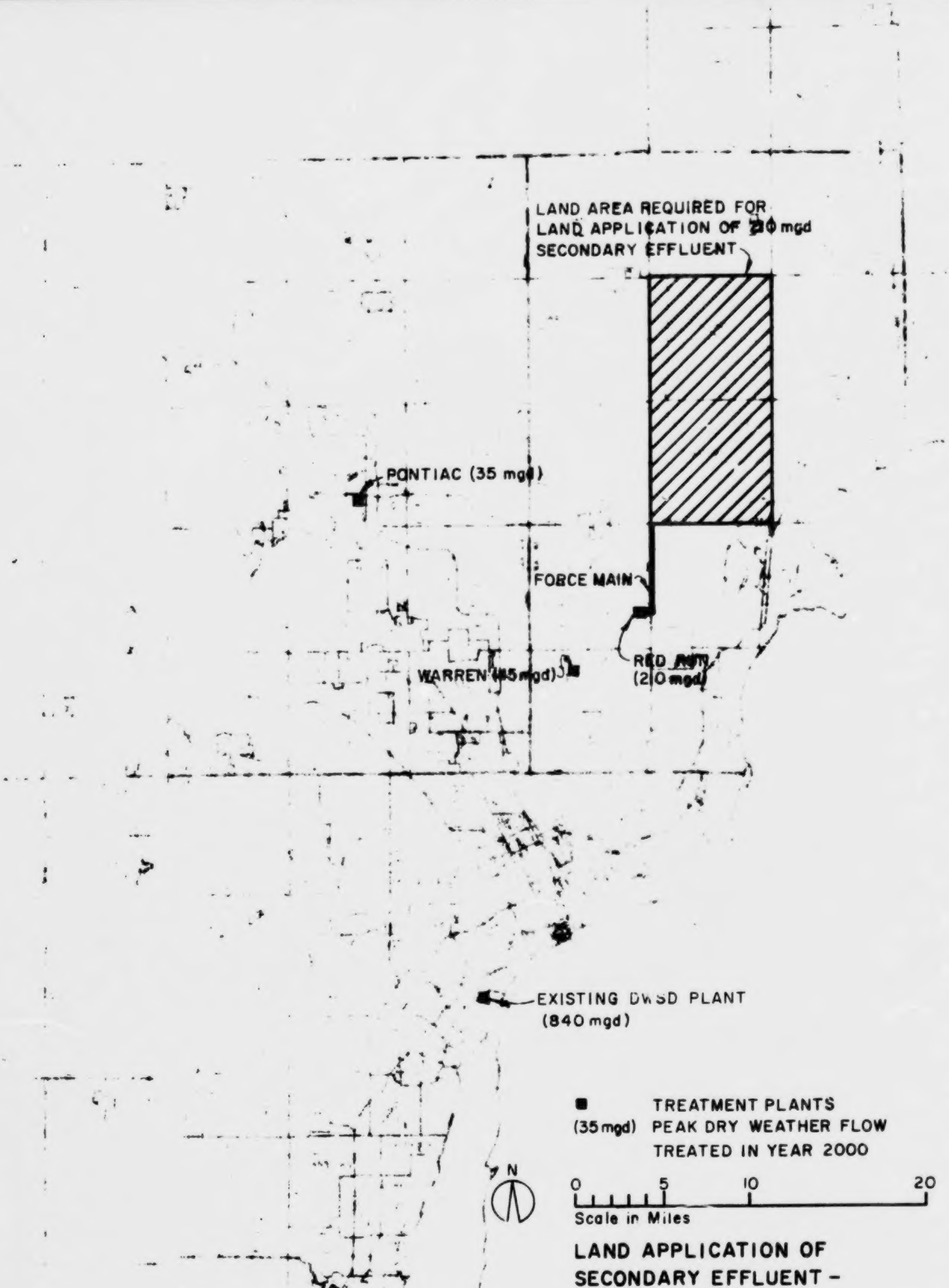
| Managing Entity | Facility | (Year 2000) Effective Capacity (mgd)* Preliminary | Primary | Secondary | Advanced |
|---|---|---|---|---|---|
| DWSD | Existing Facilities | 895 | 630 | 315 | - |
| DWSD | Mandated Construction | - | 210 | 420 | - |
| DWSD | Improved Operation | - | 120 | 105 | - |
| DWSD | Red Run | 210 | 210 | 210 | - |
| Suburban | Pontiac, Warren | 80 | 80 | 80 | 80 |
| | | 1185 | 1250 | 1130 | 80 |

* 1.0 mgd = 3785.0 $m^3/d$

## Table 5.2-R

## Alternative D1 - Monetary Cost Analysis - Million Dollars

| Facilities | Construction | Operation & Maintenance | Present Worth |
|---|---|---|---|
| Existing Plant | 203 | 31.0 | 610 |
| Red Run Plant with land application of effluent | 369 | 6.6 | 391 |
| Collection System | 92 | 5.0 | 141 |
| Overflow Control | 1108 | 4.0 | 1065 |
| | 1772 | 46.6 | 2207 |


LAND AREA REQUIRED FOR LAND APPLICATION OF 210 mgd SECONDARY EFFLUENT
PONTIAC (35 mgd)
FORCE MAIN
WARREN (45 mgd)
RED RUN (210 mgd)
EXISTING DWSD PLANT (840 mgd)
■ TREATMENT PLANTS
(35 mgd) PEAK DRY WEATHER FLOW TREATED IN YEAR 2000
N
0
5
10
20
Scale in Miles

LAND APPLICATION OF SECONDARY EFFLUENT - ALTERNATIVE DI

Figure 5.2-I

## Table 5.2-S

## Treatment Facilities and Capacities for Alternative D2-Abandon Existing Plant

| | | (Year 2000) Effective Capacity (mgd)* | | | |
|---|---|---|---|---|---|
| Managing Entity | Facility | Preliminary | Primary | Secondary | Advanced |
| DWSD | Clinton River | 95 | 95 | 95 | 95 |
| DWSD | Red Run | 95 | 95 | 95 | 95 |
| DWSD | Conner Creek | 315 | 315 | 315 | - |
| DWSD | North of Existing Site | 335 | 335 | 335 | - |
| DWSD | Metro Airport | 130 | 130 | 130 | - |
| DWSD | Pointe Mouille | 80 | 80 | 80 | - |
| Suburban | Warren, Pontiac | 80 | 80 | 80 | 80 |
| | | 1130 | 1130 | 1130 | 270 |

* 1.0 mgd = 3785.0 $m^3/d$

## Table 5.2-T

## Alternative D2 - Monetary Cost Analysis - Million Dollars

| Facilities | Construction | Operation & Maintenance | Present Worth |
|---|---|---|---|
| Clinton River | 75 | 3.8 | 110 |
| Red Run | 75 | 3.8 | 110 |
| Conner Creek | 163 | 9.1 | 250 |
| North of Existing Plant | 219 | 11.2 | 325 |
| Metro Airport | 134 | 4.8 | 198 |
| Huron River | 67 | 2.1 | 84 |
| Collection System | 102 | 6.0 | 163 |
| Overflow Control | 1108 | 4.0 | 1065 |
| Total | 1943 | 44.8 | 2305 |

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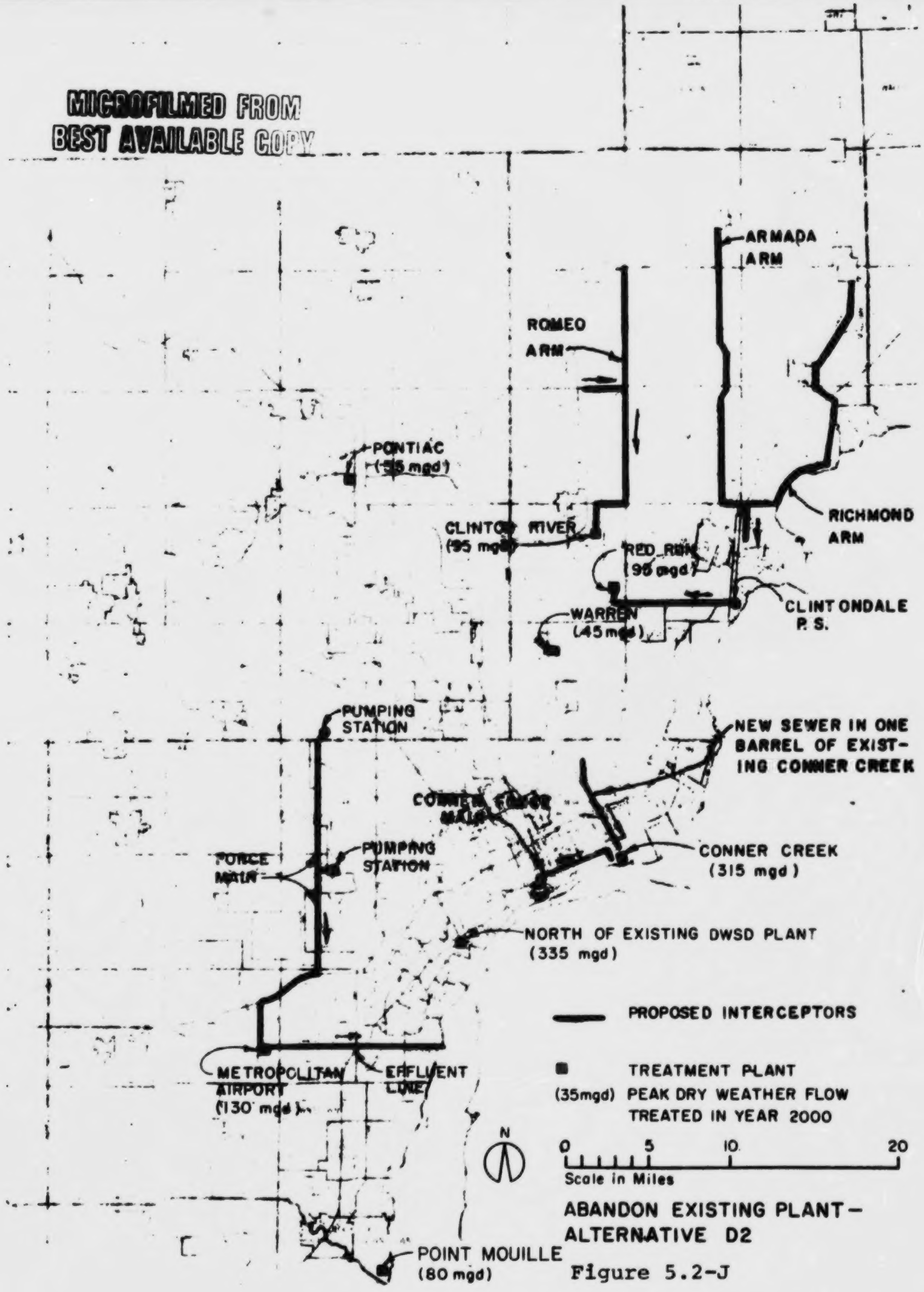

ARMADA ARM
ROMEO ARM
PONTIAC (35 mgd)
CLINTON RIVER (95 mgd)
RED RUN (95 mgd)
RICHMOND ARM
CLINTONDALE P. S.
WARREN (45 mgd)
PUMPING STATION
NEW SEWER IN ONE BARREL OF EXISTING CONNER CREEK
CONNER FORCE MAIN
FORCE MAIN
PUMPING STATION
CONNER CREEK (315 mgd)
NORTH OF EXISTING DWSD PLANT (335 mgd)
METROPOLITAN AIRPORT (130 mgd)
EFFLUENT LINE
POINT MOUILLE (80 mgd)
PROPOSED INTERCEPTORS
TREATMENT PLANT
(35mgd) PEAK DRY WEATHER FLOW TREATED IN YEAR 2000
N
0
5
10
20
Scale in Miles

ABANDON EXISTING PLANT—
ALTERNATIVE D2

Figure 5.2-J

Nineteen stormwater retention basins would be constructed along the River Rouge and Detroit River to temporarily hold CSO. Stormwater would be released back to the collection system, pumped into DWWTP and given preliminary treatment. Effluent would be discharged to the Detroit River.

The treatment facilities and capacities necessary in the year 2000 for this alternative are listed on Table 5.2-U. Figure 5.2-K shows the location of the treatment facilities. Costs for this alternative are shown on Table 5.2-V and collection system additions.

- Evaluation of Unconventional Systems Alternatives

All of the D alternatives will have short-term adverse construction impacts to soil, air, and water quality. Alternative D3 will have the fewest impacts because it involves construction of only a 50 mgd (189,250 $m^3$/d) plant north of the existing plant.

Similarly, each alternative will have long-term adverse impacts from land requirements for treatment plant sites, or with Alternative D1, land application sites. The main impact is that the land at these sites would be eliminated from any other use. The effluent disposal site would have restrictions on the type of agricultural crops grown. Alternatives D1 and D2 have large total land requirements. Alternative D3 requires only an additional 48 acre (19 ha) acquisition over the present treatment site.

Surface water impacts differ in some respects with each alternative. All alternatives are designed to meet discharge criteria and therefore lessen the present degradation to receiving water.

In Alternative D2, the four treatment plants on the Clinton River or its tributaries would receive tertiary treatment. Long-term water quality improvements are anticipated. The remaining four treatment plants would have outfalls to the Detroit River. Dispersed outfalls would have different impacts on river water quality than would a single outfall to the Detroit River at the DWWTP. Multiple discharge points may be viewed positively in terms of distributing potential water quality problems over the study area and therefore lessening the intensity of any one problem area. Any plant malfunctions would be localized and not affect all of the effluent. Multiple outfalls may also be viewed negatively in terms of multiple impacts to river water quality from effluent loadings and multiple zones of recovery downstream.

## Table 5.2-U

## Treatment Facilities and Capacities for Alternative D3 - Split Treatment

| Managing Entity | Facility | (Year 2000) Treatment Capacity (mgd)* Preliminary | Primary | Secondary+ | Advanced |
|---|---|---|---|---|---|
| DWSD | Existing Facilities | - | 135 | 300 | - |
| DWSD | Mandated Construction | - | 135 | - | - |
| DWSD | Improved Operation | - | - | - | - |
| DWSD | Conversion | - | 450 | - | - |
| DWSD | New Facilities | 2600 | 430 | - | - |
| Suburban | Pontiac, Warren | 80 | 80 | 80 | 80 |
| | | 2680 | 1230 | 380 | 80 |

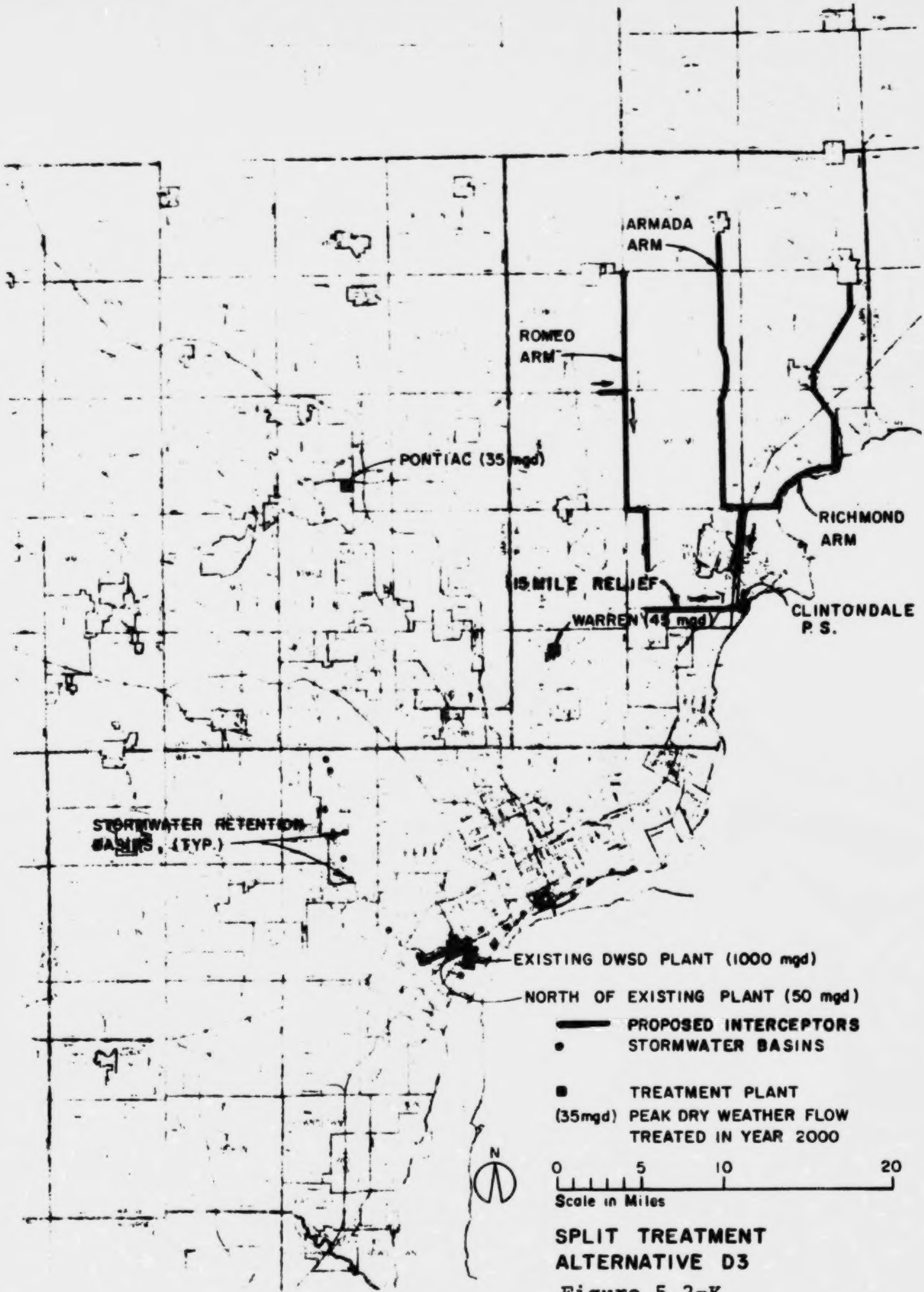
* 1.0 mgd = 3785.0 $m^3/d$

+ All final effluent from existing plant will meet discharge requirements of 30 mg/l SS and 30 mg/l BOD.

## Table 5.2-V

## Alternative D3 - Monetary Cost Analysis - Million Dollars

| Facilities | Construction | Operation & Maintenance | Present Worth |
|---|---|---|---|
| Existing Plant | 555 | 40.5 | 1000 |
| Collection System | 147 | 6.0 | 203 |
| Overflow Control | 835 | 0.8 | 740 |
| Total | 1537 | 47.3 | 1943 |



ARMADA ARM
ROMEO ARM
PONTIAC (35 mgd)
RICHMOND ARM
15 MILE RELIEF
WARREN (45 mgd)
CLINTONDALE P.S.
STORMWATER RETENTION BASINS, (TYP.)
EXISTING DWSD PLANT (1000 mgd)
NORTH OF EXISTING PLANT (50 mgd)
PROPOSED INTERCEPTORS
● STORMWATER BASINS
■ TREATMENT PLANT
(35mgd) PEAK DRY WEATHER FLOW TREATED IN YEAR 2000
N
0
5
10
20
Scale in Miles

SPLIT TREATMENT
ALTERNATIVE D3

Figure 5.2-K

Alternative D3 provides more preliminary treatment capacity than the other options. Impacts to surface water quality from stormwater and CSO would be less severe than any other alternative.

Alternative D1 will have surface water quality impacts to the Detroit River from the existing plant run at optimum operation. Potential soil impacts from applying secondary effluent, such as those resulting from heavy metals and the concentration of certain ions, would need further study. Potential impacts to groundwater exist in the form of groundwater contamination by either bacteria or nitrates.

In view of these environmental impacts, plus other screening criteria such as costs and implementability, Alternatives D1 and D2 have been eliminated. The former is not considered feasible due to the extremely large areal requirements for land application sites and the associated potential environmental impacts. The operational problems and environmental impacts associated with several treatment plants and the high cost compared to other D alternatives eliminates Alternative D2 from further consideration. Alternative D3 appears to be the most feasible in terms of cost, potential for energy and land requirement savings, and relatively less severe environmental impacts to land, air, and water. This alternative will be given further evaluation.

### 5.2.2 West Arm Alternatives Screening

The screening presents five collection alternatives for the West Arm. The facilities planning consultant elected to not include western Wayne County because it is the subject of a suburban facilities plan.

The facilities planning consultant elected to allow twelve overflows per year as a design criteria based on the cost of allowing twelve, four, or one combined sewer overflow(s) per year. Design criteria used by the facilities planning consultant shows that approximately 29,000 acre feet (9.5 billion gallons) overflows to the River Rouge at present. A design allowing one overflow per year would allow about 820 acre feet 9267 million gallons) to overflow annually. The four overflows per year design would allow 4,510 acre feet (1.5 billion gallons) to overflow, and the twelve overflow design would allow 9,020 acre feet (2.9 billion gallons) to overflow (Giffels/Black and Veatch, 1977, WA-SFP).

The cost of reducing the overflows from twelve to four and to one per year are quite high. The cost to reduce overflows from twelve to four would range from 132 to 174 million dollars, depending upon the alternative examined. The cost of reducing overflows from twelve to one per year ranges from 424 to 365 million dollars (Giffels/Black and Veatch, 1977, WA-SFP).

### 5.2.2.1 Alternative A

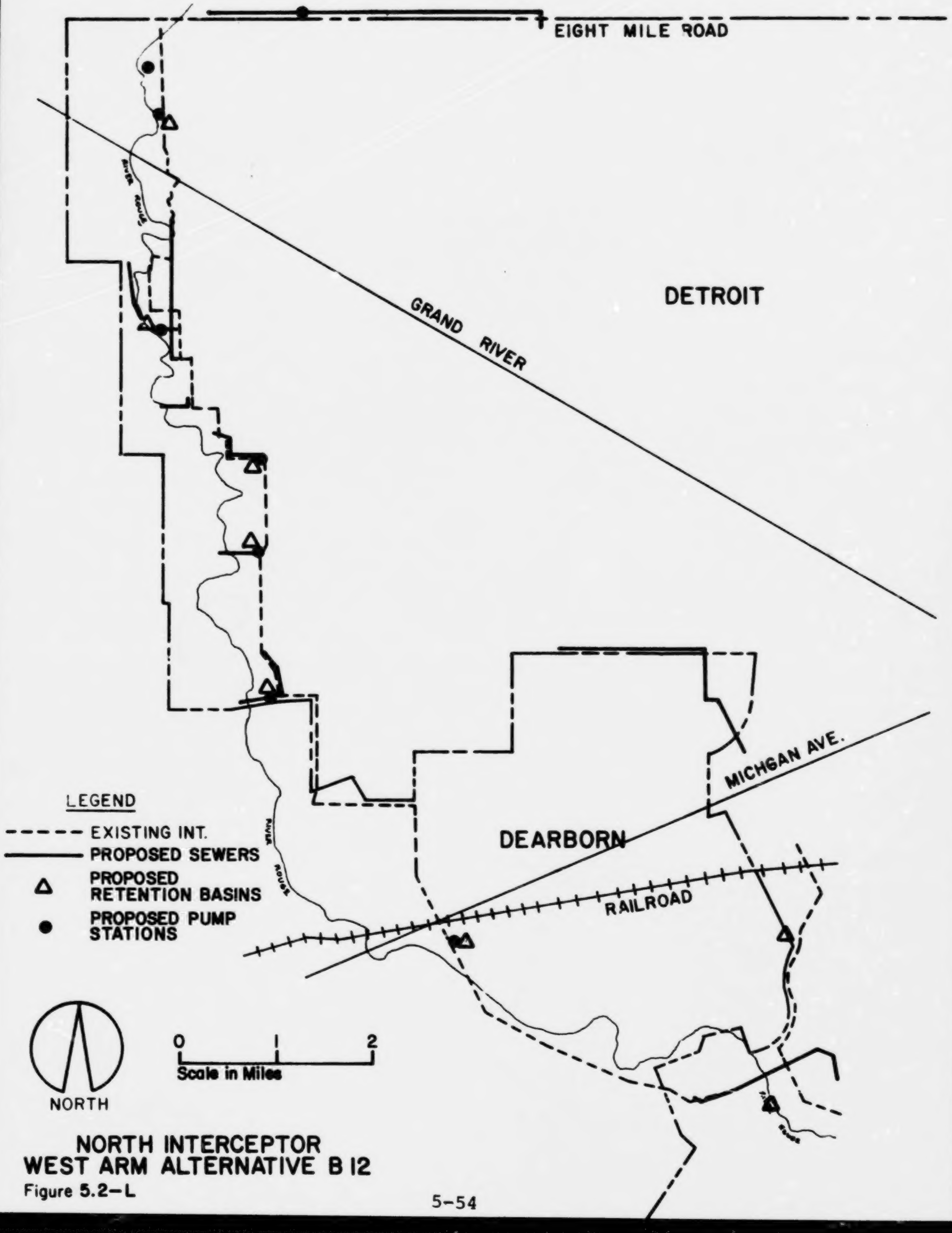
Alternative A is the no action alternative. No additional PL 92-500 funds would be expended beyond current contractual commitments. The Oakwood-Northwest interceptor will continue to overflow during storm events. Combined sewer overflows will increase in frequency and volume due to flow constrictions in the existing systems.

### 5.2.2.2 Alternative B12

Alternative B12 (Figure 5.2-L) proposes to utilize the existing excess capacity in the Baby Creek sewer to reduce CSO to the River Rouge and construct retention basins. The alternative is proposed to construct the following elements in three phases:

Phase I

1. Construction of approximately 15,000 feet (4500 m) of 144 inch tunnel sewer from the sewage treatment plant to a connection with the Northwest Interceptor near Schaefer Highway;
2. Construction of a new pumping station at the sewage treatment plant;
3. The Murwood pumping station on 8 Mile Road would be abandoned and the 54 inch line running into it from the west would be extended to Evergreen Road. A 115 mgd (435,275 $m^3/d$) pumping station located at this point would pump all of the flow from the Evergreen-Farmington District through a 72 inch force main to the intersection of Norfolk and Hubbell where it would discharge to the Hubbell sewer; and
4. Construction of a 180 inch gravity sewer from the intersection of Hubbell and Tiremen to the intersection of Lonyo and Kirkwood. The sewer would divert flow for storms up to a one-year recurrence interval from the Hubbell District to the Baby Creek sewer, thereby relieving the Northwest Interceptor. The Baby Creek sewer is adequately sized to carry this additional flow. During storms exceeding a one-year storm, excess flows would relieve to the River Rouge through the Hubbell-Southfield outfall.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RIVER ROUGE
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- - - - - EXISTING INT.
——— PROPOSED SEWERS
△ PROPOSED RETENTION BASINS
● PROPOSED PUMP STATIONS
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2
Scale in Miles
NORTH

NORTH INTERCEPTOR
WEST ARM ALTERNATIVE B 12

Figure 5.2—L

Phase II

1. Construction of the following CSO facilities:

| Location | Storage Capacity (acre feet) | Pumping Station Capacity (mgd) |
|---|---|---|
| Pembroke and Berg | 15 | 95 |
| 7 Mile and Berg | 4 | 25 |
| Eliza Howell Park | 70 | 235 |
| Fullerton and Burt | 19 | 420 |
| West Chicago and Burt | 50 | 175 |
| Warren and Pierson | 41 | 105 |

2. Construction of sewers to convey the CSO from the existing outfalls to the new stormwater retention facilities.

Phase III

1. Construction of the following CSO facilities:

| Location | Storage Capacity (acre feet) | Pumping Station Capacity (mgd) |
|---|---|---|
| Michigan & Southfield | 44 | 90 |
| Patton Park (near Woodmere P.S.) | 263 | 800 |
| Oakwood P.S. | 17 | 160 |
| Treatment Plant | 60 | - |

The facilities planning consultant estimated the total cost of Alternative B12 to be 223 million dollars. The costs are broken down as follows:

| | | |
|---|---|---|
| Phase I | | |
| 1. Tunnel sewer | $10,000,000 | |
| 2. Pumping station (prorated portion) | 15,000,000 | |
| 3. Oakland County pumping station and force main | 17,000,000 | |
| 4. Hubbell relief sewer | 17,000,000 | |
| | | $ 59,000,000 |
| Phase II | | |
| 1. Retention facilities | $71,000,000 | |
| 2. Connecting sewers | 10,000,000 | |
| | | $ 81,000,000 |
| Phase III | | |
| 1. Retention facilities | $83,000,000 | |
| | | $ 83,000,000 |
| Total Plan B12 | | $223,000,000 |

### 5.2.2.3 Alternative C12

This alternative would result in a large tunnel sewer from 8 Mile Road to the DWWTP. The alternative would be constructed in two phases, the first taking as long as two phases on other alternatives and would consist of the following elements (Figure 5.2-M):

Phase I

1. Construction of a tunnel sewer with seven relief connections to the existing City of Detroit sewers;
2. Construction of a new pumping station at the sewage treatment plant;
3. Construction of seven sewers from outfall structures along the River Rouge to the tunnel; and
4. Construction of a sewer along 8 Mile Road to connect to Evergreen-Farmington.

Phase II

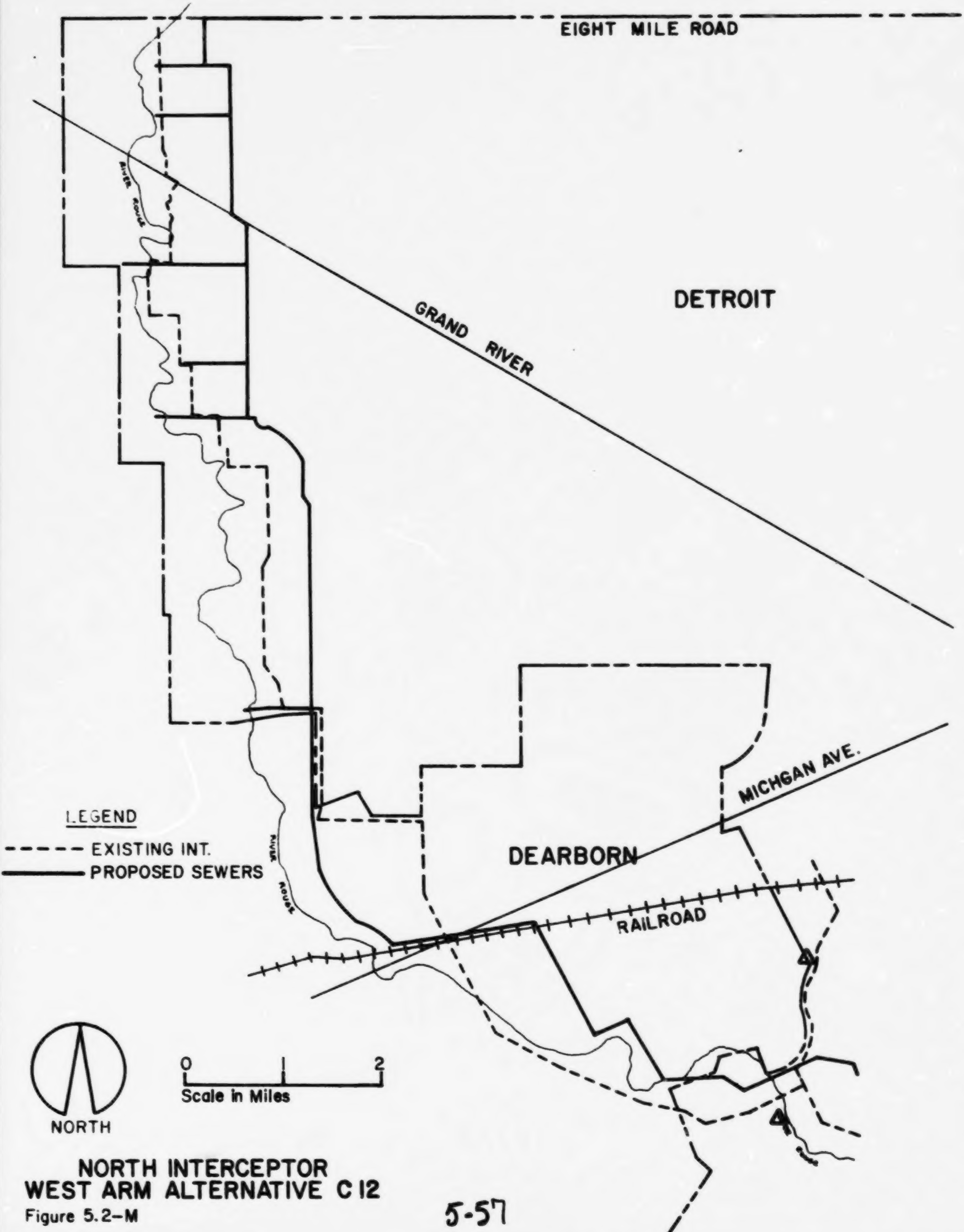
1. Construction of the following CSO retention facilities:

| Location | Storage Capacity (acre feet) | Pumping Station Capacity (mgd) |
|---|---|---|
| Patton Park (near Woodmere P.S.) | 220 | 615 |
| Oakwood P.S. | 17 | 160 |
| Treatment Plant | 180 | - |

2. Additions at the DWWTP main pumping station to increase its capacity to 570 mgd (2,157,450 $m^3/d$).

The facilities planning consultant estimated the total cost of Alternative C12 to be 221 million dollars. The cost of the major segments are as follows:

| | | |
|---|---|---|
| Phase I | | |
| 1. Tunnel sewer | $110,000,000 | |
| 2. Pumping station (prorated portion) | 19,000,000 | |
| 3. Detroit relief sewer | 7,000,000 | |
| 4. Evergreen sewer | 1,000,000 | |
| | | $137,000,000 |
| Phase II | | |
| 1. Retention facilities | $ 79,000,000 | |
| 2. Pumping station additions | 5,000,000 | |
| | | $ 84,000,000 |
| Total Plan C12 | | $221,000,000 |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PROPOSED SEWERS
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Scale in Miles
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NORTH INTERCEPTOR
WEST ARM ALTERNATIVE C 12
Figure 5.2-M

### 5.2.2.4 Alternative D12

This alternative is similar to Alternative C12 in that a tunnel sewer would be constructed from 8 Mile Road to the DWWTP. The proposed alternative would require stormwater retention basins along the River Rouge (Figure 5.2-N).

The elements that make up Alternative D12 are as follows:

Phase I (1980)

1. Construction of a tunnel sewer with seven relief connections to the existing City of Detroit sewers;
2. Construction of a new pumping station at the sewage treatment plant; and
3. Construction of a sewer along 8 Mile Road to convey flows from the eastern portion of the Evergreen-Farmington Districts to the tunnel.

Phase II

1. Construction of the following CSO retention facilities:

| Location | Storage Capacity (acre feet) | Pumping Station Capacity (mgd) |
|---|---|---|
| Pembroke and Berg | 13 | 95 |
| 7 Mile and Berg | 3 | 25 |
| Eliza Howell Park | 60 | 235 |
| Fullerton and Burt | 16 | 420 |
| West Chicago and Burt | 43 | 175 |
| Warren and Pierson | 35 | 105 |

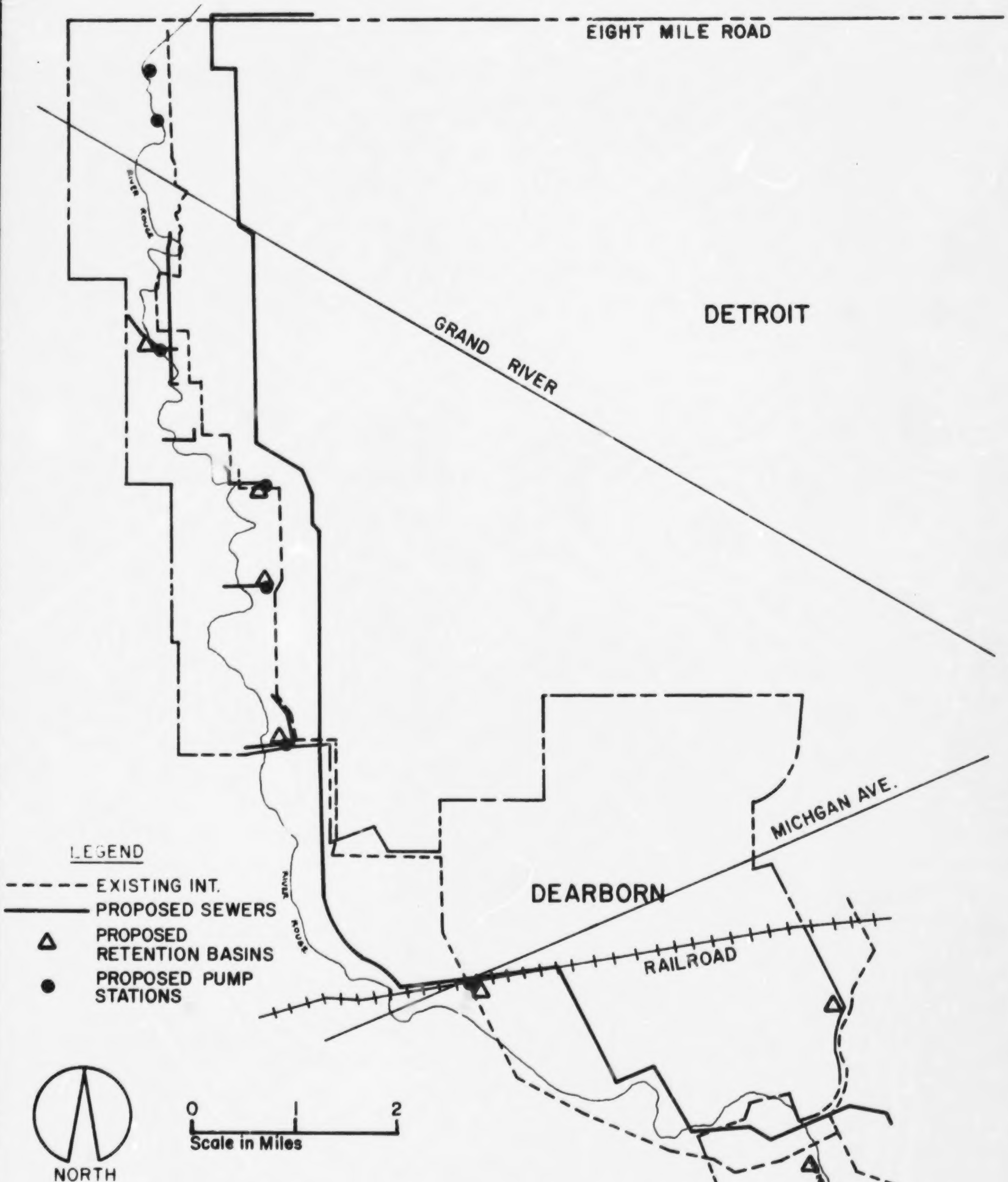
2. Construction of sewers to convey the CSO from the existing outfalls to the new retention facilities.

Phase III (1990)

1. Construction of the following CSO retention facilities:

| Location | Storage Capacity (acre feet) | Pumping Station Capacity (mgd) |
|---|---|---|
| Michigan and Southfield | 53 | 530 |
| Patton Park (near Woodmere P.S.) | 220 | 615 |
| Oakwood P.S. | 17 | 160 |
| Treatment Plant | 110 | - |

2. Construction of sewers to convey the CSO from the existing outfalls to the new retention facilities.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RIVER ROUGE
RIVER ROUGE
ROUGE
LEGEND
EXISTING INT.
PROPOSED SEWERS
PROPOSED RETENTION BASINS
PROPOSED PUMP STATIONS
NORTH
0
1
2
Scale in Miles

NORTH INTERCEPTOR
WEST ARM ALTERNATIVE D 12
Figure 5.2-N

The facilities planning consultant estimated the total cost of Alternative D12 to be as follows:

| | | |
|---|---|---|
| Phase I | | |
| 1. Tunnel sewer | $66,000,000 | |
| 2. Pumping station (prorated portion) | 16,000,000 | |
| 3. 8 Mile sewer | 1,000,000 | |
| | | $ 83,000,000 |
| Phase II | | |
| 1. Retention facilities | $60,000,000 | |
| 2. Connecting sewers | 10,000,000 | |
| | | $ 70,000,000 |
| Phase III | | |
| 1. Retention facilities | $92,000,000 | |
| 2. Pumping station additions | 1,000,000 | |
| | | $ 93,000,000 |
| Total D12 | | $246,000,000 |

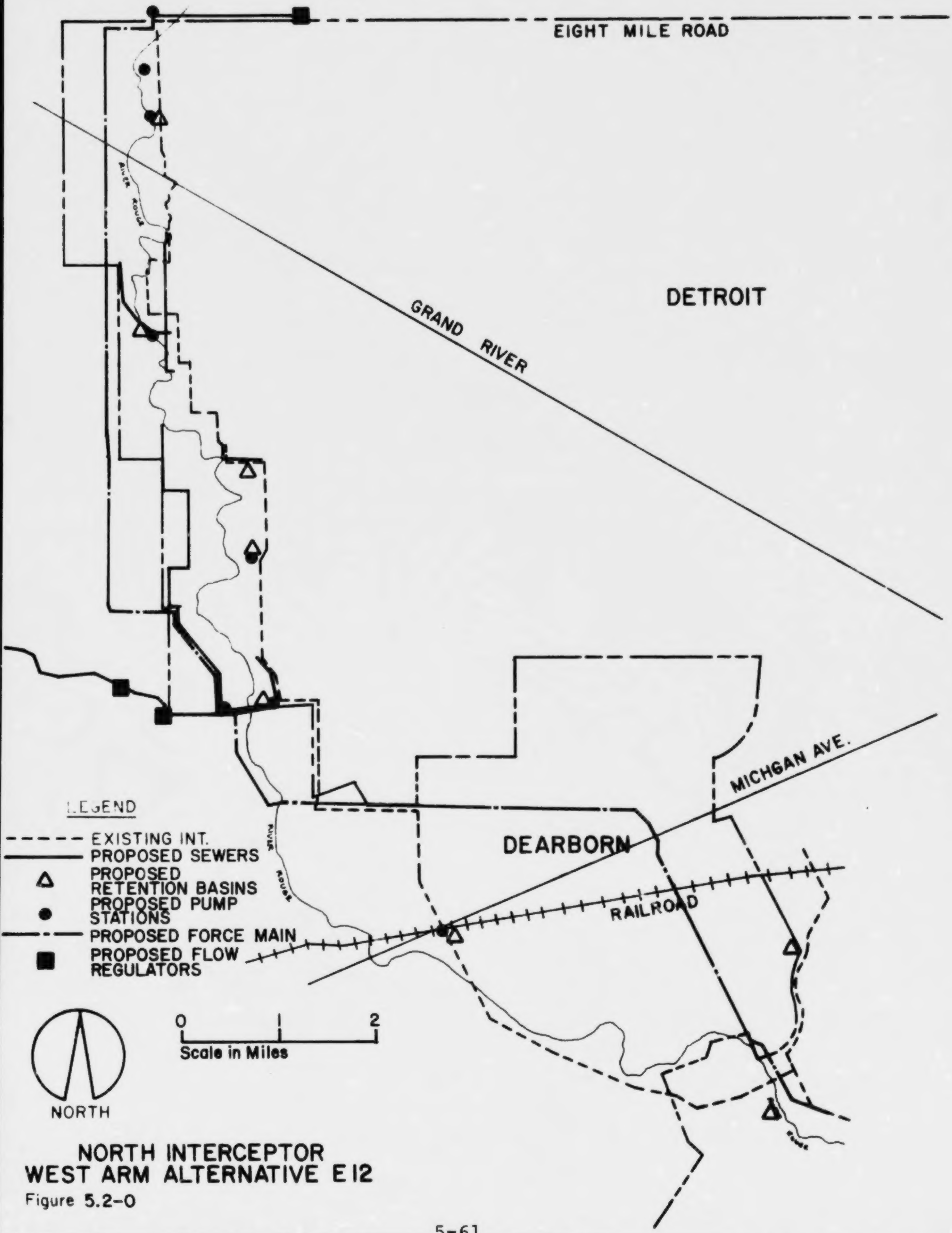
### 5.2.2.5 Alternative E12

This alternative would construct a pump station and force main to transport Oakland County sewage flows to the DWWTP (Figure 5.2-O). Stormwater retention basins would reduce CSO.

The elements of Alternative E12 are as follows:

Phase I (1980)

1. Construction of a 115 mgd (435,275 $m^3$/d) pumping station at 8 Mile Road and Berg for Oakland County flows and a sewer along 8 Mile Road to connect to the Oakland County Evergreen sewer;
2. Construction of a 72 inch force main from the pumping station to Warren Road and Parkland;
3. Construction of a 60 mgd (227,100 $m^3$/d) pumping station at Warren and Parkland;
4. Construction of a 96 inch force main from Warren-Parkland pumping station to the sewage treatment plant;
5. Construction of a new pumping station at the sewage treatment plant; and
6. Construction of a sewer to convey separate sanitary sewage from the Middle Rouge Valley of Western Wayne County to the Warren-Parkland pumping station. Because this sewer is essentially a suburban collection facility, its cost is not included in the project estimates.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GRAND RIVER
RIVER ROUGE
DEARBORN
MICHGAN AVE.
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RIVER ROUGE
LEGEND
EXISTING INT.
PROPOSED SEWERS
△ PROPOSED RETENTION BASINS
● PROPOSED PUMP STATIONS
PROPOSED FORCE MAIN
■ PROPOSED FLOW REGULATORS
0
1
2
Scale in Miles
NORTH

NORTH INTERCEPTOR
WEST ARM ALTERNATIVE E12
Figure 5.2-0

Phase II (1985)

1. Construction of the following CSO retention facilities:

| Location | Storage Capacity (acre feet) | Pumping Station Capacity (mgd) |
|---|---|---|
| Pembroke and Berg | 15 | 95 |
| 7 Mile and Berg | 4 | 25 |
| Eliza Howell Park | 70 | 235 |
| Fullerton and Burt | 14 | 390 |
| West Chicago and Burt | 41 | 145 |
| Warren and Pierson | 59 | 135 |

2. Construction of sewers to convey the CSO from the existing outfalls to the new retention facilities.

Phase III (1990)

1. Construction of the following CSO retention facilities:

| Location | Storage Capacity (acre feet) | Pumping Station Capacity (mgd) |
|---|---|---|
| Michigan and Southfield | 222 | 580 |
| Patton Park (near Woodmere P.S.) | 220 | 615 |
| Oakwood P.S. | 17 | 160 |

The facilities planning consultant estimated the construction cost of alternative E12 to be 257 million dollars. The costs of the alternative's elements are as follows:

| | | |
|---|---|---|
| Phase I | | |
| 1. Pumping station (115 mgd) | $ 5,000,000 | |
| 2. Force main (72 inch) | 14,000,000 | |
| 3. Pumping station (60 mgd) | 3,000,000 | |
| 4. Force main (96 inch) | 23,000,000 | |
| 5. Pumping station (prorated portion) | 13,000,000 | |
| | | $ 58,000,000 |
| Phase II | | |
| 1. Retention facilities | $91,000,000 | |
| 2. Connecting sewers | 14,000,000 | |
| | | $105,000,000 |

| | | |
|---|---|---|
| Phase III | | |
| 1. Retention facilities | $94,000,000 | |
| | | $ 94,000,000 |
| Total E12 WO | | $257,000,000 |

### 5.2.2.6 Alternative F12

Alternative F12 would construct two secondary sewage treatment plants along the River Rouge with an effluent force main to the Detroit River. Stormwater retention basins would be constructed during Phases II and III (Figure 5.2-P). The major elements of this alternative are as follows:

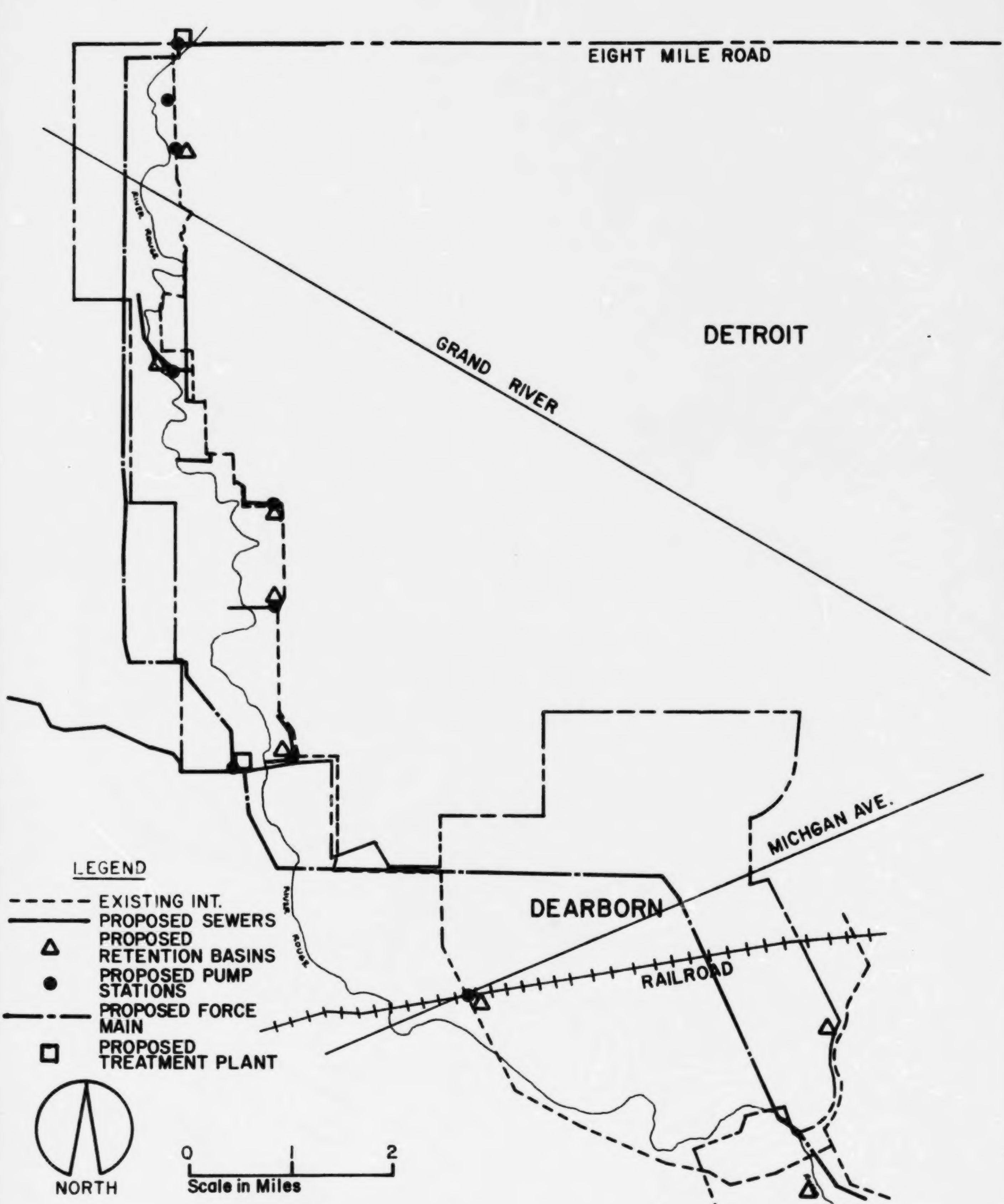
Phase I (1980)

1. Construction of a secondary sewage treatment plant with a design capacity of 50 mgd (189,250 $m^3/d$) and a peak hydraulic capacity of 115 mgd (435,275 $m^3/d$) near 8 Mile Road and Berg and a sewer along 8 Mile Road to connect to the Oakland County Evergreen sewer;
2. Construction of a 72 inch effluent force main from the treatment plant to Warren Road and Parkland;
3. Construction of a secondary sewage treatment plant with a design capacity of 23 mgd (87,055 $m^3/d$) and a peak hydraulic capacity of 60 mgd (227,100 $m^3/d$) near Warren Road and Parkway;
4. Construction of a 96 inch effluent force main from the Warren-Parkway treatment plant to an outfall into the Detroit River. Construction of a new pumping station at the sewage treatment plant; and
5. Construction of a sewer to convey separate sanitary sewage from the Middle Rouge Valley of western Wayne County to the Warren-Parkland treatment plant. Because this sewer is essentially a suburban collection facility, its cost is not included in the project estimates.

Phase II (1985)

1. Construction of the following CSO retention facilities:

| Location | Storage Capacity (acre feet) | Pumping Station Capacity (mgd) |
|---|---|---|
| Pembroke and Berg | 15 | 95 |
| 7 Mile and Berg | 4 | 25 |
| Eliza Howell Park | 70 | 235 |
| Fullerton and Burt | 19 | 420 |
| West Chicago and Burt | 50 | 175 |
| Warren and Pierson | 41 | 105 |


EIGHT MILE ROAD
DETROIT
GRAND RIVER
RIVER ROUGE
MICHGAN AVE.
DEARBORN
RAILROAD
RIVER ROUGE
LEGEND
EXISTING INT.
PROPOSED SEWERS
PROPOSED RETENTION BASINS
PROPOSED PUMP STATIONS
PROPOSED FORCE MAIN
PROPOSED TREATMENT PLANT
NORTH
0
1
2
Scale in Miles

NORTH INTERCEPTOR
WEST ARM ALTERNATIVE F12

Figure 5.2-P

2. Construction of sewers to convey the CSO from the existing outfalls to the new retention facilities.

Phase III (1990)

1. Construction of the following CSO retention facilities:

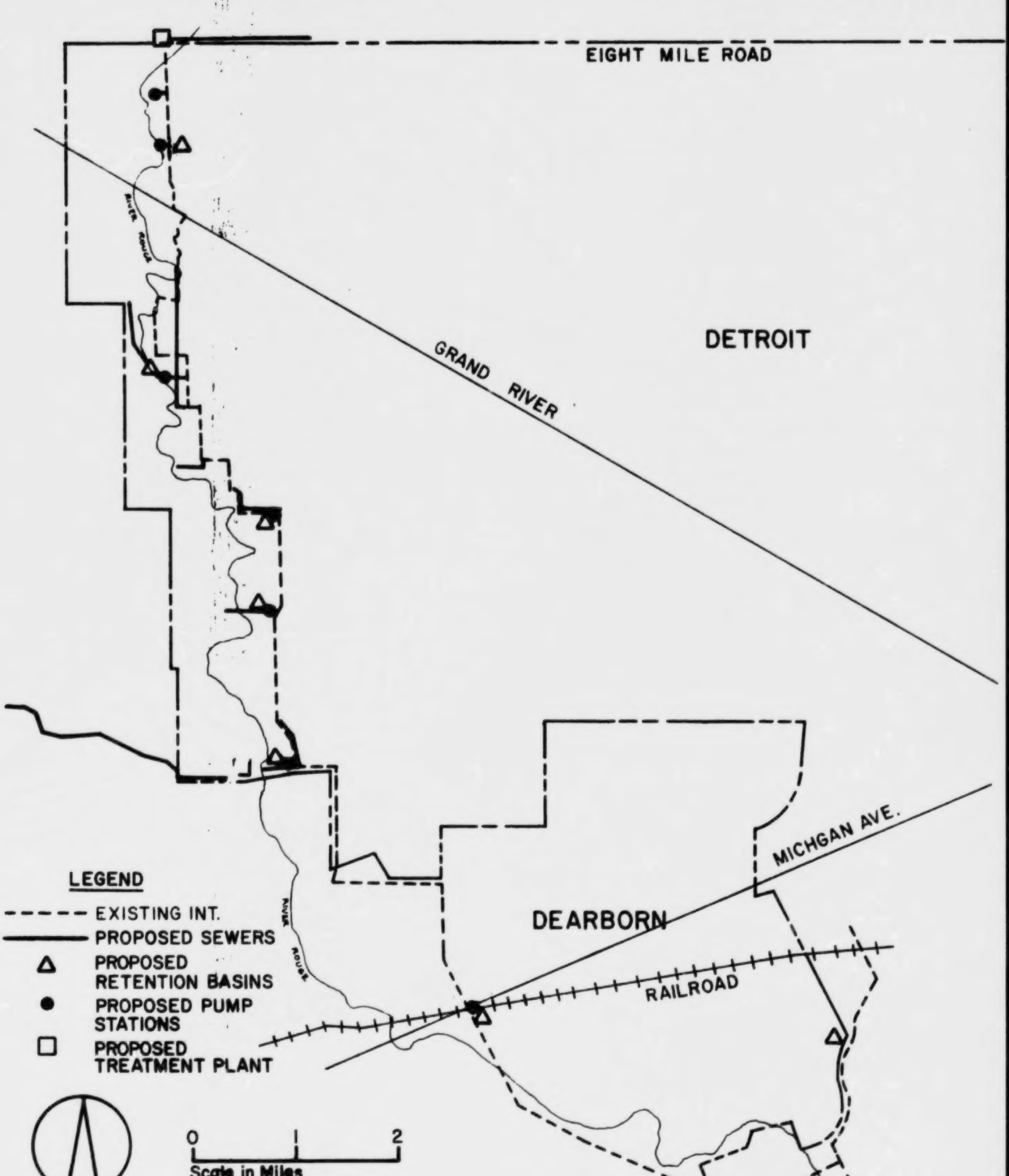
| Location | Storage Capacity (acre feet) | Pumping Station Capacity (mgd) |
|---|---|---|
| Michigan and Southfield | 85 | 580 |
| Patton Park (near Woodmere P.S.) | 310 | 615 |
| Oakwood P.S. | 12 | 160 |

The facilities planning consultant (Giffels/Black and Veatch, 1977, WA-SFP) estimated the total cost of Alternative F12 at 273 million dollars. The costs of the various elements by phases are as follows:

| | | |
|---|---|---|
| Phase I | | |
| 1. Sewage treatment plant (50 mgd) | $36,000,000 | |
| 2. Force main (72 inch) | 14,000,000 | |
| 3. Sewage treatment plant (23 mgd) | 18,000,000 | |
| 4. Force main (96 inch) | 20,000,000 | |
| 5. Pumping station (prorated portion) | 12,000,000 | |
| | | $100,000,000 |
| Phase II | | |
| 1. Retention facilities | $71,000,000 | |
| 2. Connecting sewers | 10,000,000 | |
| | | $ 81,000,000 |
| Phase III | | |
| 1. Retention facilities | $92,000,000 | |
| | | $ 92,000,000 |
| Total Plan F12 | | $273,000,000 |

### 5.2.2.7 Alternative G12

The basic elements of Alternative G12 are similar to Alternative F12 except that the two sewage treatment plants would be of an advanced treatment type to allow discharge of the effluent directly to the River Rouge (Figure 5.2-Q). The proposed elements of Alternative G12 are as follows:


EIGHT MILE ROAD
RIVER ROUGE
GRAND RIVER
DETROIT
MICHGAN AVE.
DEARBORN
RIVER ROUGE
RAILROAD
ROUGE
LEGEND
EXISTING INT.
PROPOSED SEWERS
PROPOSED RETENTION BASINS
PROPOSED PUMP STATIONS
PROPOSED TREATMENT PLANT
NORTH
0
1
2
Scale in Miles

NORTH INTERCEPTOR
WEST ARM ALTERNATIVE G 12

Figure 5.2-Q

Phase I (1980)

1. Construction of an advanced sewage treatment plant with a design capacity of 50 mgd (189,250 $m^3/d$) and a peak hydraulic capacity of 115 mgd (435,275 $m^3/d$) near 8 Mile Road and Berg and a sewer along 8 Mile Road to connect to the Oakland County Evergreen sewer;
2. Construction of an advanced sewage treatment plant with a design capacity of 23 mgd (87,055 $m^3/d$) and a peak hydraulic capacity of 60 mgd (227,100 $m^3/d$) near Warren Road and Parkway;
3. Construction of a new pumping station at the sewage treatment plant; and
4. Construction of a sewer to convey separate sanitary sewage from the Middle Rouge Valley of western Wayne County to the Warren-Parkland treatment plant. Because this sewer is essentially a suburban collection facility, its cost is not included in the project estimates.

Phase II

1. Construction of the following CSO retention facilities:

| Location | Storage Capacity (acre feet) | Pumping Station Capacity (mgd) |
|---|---|---|
| Pembroke and Berg | 15 | 95 |
| 7 Mile and Berg | 4 | 25 |
| Eliza Howell Park | 70 | 235 |
| Fullerton and Burt | 19 | 420 |
| West Chicago and Burt | 50 | 175 |
| Warren and Pierson | 41 | 105 |

2. Construction of sewers to convey the CSO from the existing outfalls to the new retention facilities.

Phase III (1990)

Construction of the following CSO retention facilities:

| Location | Storage Capacity (acre feet) | Pumping Station Capacity (mgd) |
|---|---|---|
| Michigan and Southfield | 85 | 580 |
| Patton Park (near Woodmere P.S.) | 310 | 615 |
| Oakwood P.S. | 12 | 160 |

The facilities planning consultant (Giffels/Black and Veatch, 1977, WA-SFP) estimated the cost of Alternative G12 to be 266 million dollars. The costs of the various elements of the Alternative are as follows:

| | | |
|---|---|---|
| Phase I | | |
| 1. Sewage treatment plant (50 mgd) | $52,000,000 | |
| 2. Sewage treatment plant (23 mgd) | 29,000,000 | |
| 3. Pumping station (prorated portion) | 12,000,000 | |
| | | $ 93,000,000 |
| Phase II | | |
| 1. Retention facilities | $71,000,000 | |
| 2. Connecting sewers | 10,000,000 | |
| | | $ 81,000,000 |
| Phase III | | |
| 1. Retention facilities | $92,000,000 | |
| | | $ 92,000,000 |
| Total Plan G12 | | $266,000,000 |

### 5.2.2.8 Evaluation of the West Arm Alternatives

All of the West Arm alternatives will have short-term adverse construction impacts to soil, air, water quality, and socioeconomics. Alternative G will have the fewest short-term impacts because it concentrates construction at the two advanced sewage treatment plants and does not build a lengthy tunnel or force main.

Each alternative will have long-term impacts due to the pump station sites, the retention basins (except Alternative C), and the treatment plant sites in Alternatives F and G.

Surface water impacts differ in some respects with each alternative. All alternatives are designed to lessen the degradation of the River Rouge.

The treatment plants in Alternative G would improve the River Rouge water quality due to the quality of the effluent and the flow in the river. The remaining alternatives would improve water quality in the River Rouge by eventually transporting the stormwater (partially or not at all treated) to the Detroit River.

Alternative C would provide most immediate relief to the CSO.

Due to the environmental impacts, costs, and implementability, Alternatives F12 and G12 were eliminated in the screening of alternatives. The costs, the impacts of the treatment plants and their effluent force main, and the impacts of constructing the stormwater retention basin systems make Alternative F12 not feasible.

Alternative G12 reduces the impacts due to the lack of an effluent force main to the Detroit River; however, the costs, the treatment plant sites, and implementation difficulties remove this alternative from further consideration.

During July to November 1977, the facilities planning consultant revised these alternatives and their costs. An additional alternative was also added. These additions and changes will be the subject of the evaluation phase.

## 5.3 Evaluation of Collection and Treatment Alternatives

This section evaluates more completely all the alternatives that were considered feasible during the screening. As in the screening, the West Arm is analyzed separately. Human and natural environmental impacts are compared and the result is the selection of a recommended plan for the collection and treatment of wastewater in the study area.

The environmental analysis is presented in two parts. The first section discusses, in a written narrative, impacts common to all alternatives. The second section is a matrix presenting differential impacts in tabular form. This format permits rapid identification of the differential impacts while minimizing the size of the evaluation. Areas determined not to have an impact are not presented.

### 5.3.1 Description of Feasible Collection and Treatment Alternatives

Each of the four feasible systems are briefly reviewed and only major features are pointed out. The seventeen major relief lines of the Combined Sewer Relief System are the same for each alternative.

#### 5.3.1.1 Alternative A2b - Additional Treatment in Detroit, Do Nothing by DWSD

Alternative A2b involves mandated construction at the existing plant but no upgrading to existing facilities. A 315 mgd (1,192,275 $m^3/d$) facility constructed at Conners Creek would be operated by some entity other than DWSD. The quantity of effluent receiving secondary treatment meets the project objectives but effluent quality will not meet NPDES permit levels.

Major collection system components include the Romeo, Armada, and Richmond Arms of the suburban collection system and interceptors for the Conners Creek plant. Eighteen stormwater treatment plants located along the River Rouge and Detroit River will give preliminary treatment to CSO.

#### 5.3.1.2 Alternative B2 - Optimization at Design Capacity

Alternative B2 involves mandated construction at the existing plant plus any further construction needed to bring the plant up to its design capacity. This construction would include a 50 mgd (189,250 $m^3/d$) plant north of the DWWTP that may not be needed until late in the study period. The quantity of effluent receiving secondary treatment meets the project objectives and effluent quality is expected to meet discharge criteria.

Collection system additions include the Romeo, Armada, and Richmond interceptor arms and the Clintondale pumping station. Eighteen stormwater treatment plants located along the River Rouge and Detroit River are designed to provide preliminary treatment for CSO.

#### 5.3.1.3 Alternative C2b - Additions to Optimized Plant, 2730 mgd Preliminary Capacity

As in the previous alternative, this option would involve mandated construction and upgrading of the DWWTP to meet design capacity, i.e. 1050 mgd (3,974,250 $m^3/d$). This construction would include a 50 mgd (189,250 $m^3/d$) secondary treatment facility north of the existing plant. Secondary effluent quantity and quality meet project objectives and discharge criteria, respectively.

A completely new pumping station handling 2400 mgd (9,084,000 $m^3/d$) would expand preliminary treatment at the main plant to 2730 mgd (10,333,050 $m^3/d$). Nineteen stormwater retention basins along the River Rouge and Detroit River would temporarily hold CSO until they are given preliminary treatment at the DWWTP. Proposed collection system additions include the Romeo, Armada, and Richmond interceptor arms, the 15 Mile Relief Sewer and the Clintondale pumping station.

#### 5.3.1.4 Alternative D3 - Split Treatment

This alternative replaces conventional secondary treatment at DWWTP with a split chemical/physical treatment. Chemical removal of phosphorus is followed by primary sedimentation. A 300 mgd (1,135,500 $m^3/d$) activated sludge module would further reduce soluble BOD by blending the activated sludge effluent with the primary effluent. Secondary effluent standards would be met with this combination of processes.

Combined sewer overflows would be collected and temporarily held in nineteen stormwater retention basins along the River Rouge and Detroit River. A new 2600 mgd (9,841,000 $m^3/d$) pumping station will dewater the flow to the DWWTP where it will receive preliminary treatment. Major collection system additions include the Romeo, Armada, and Richmond interceptor arms, the 15 Mile Relief Sewer and the Clintondale pumping station.

### 5.3.2 Impacts of the Feasible Alternatives

Air quality would be impacted insignificantly by the treatment alternatives if operated and maintained properly. While occasional odors may be emitted, they are not expected to be significant or frequent.

Groundwater would be minimally impacted by any of the alternatives. Little demand for groundwater exists and little is foreseen.

Aquatic biota would be minimally affected by any of the alternatives. The existing biotic community reflects the degraded water quality conditions and future water quality is not expected to undergo any major improvements.

Terrestrial biota would be minimally affected by any of the alternatives because the majority of construction will occur in an urban setting. Construction of retention basins in recreational areas will temporarily disrupt biota. No endangered species would be affected by any of the alternatives.

Future population would not be affected by the alternatives on a regional basis because sufficient urban area exists for expansion and development. Population location would be insignificantly affected for the same reason. Changes in the location of regional employment would not be discernible because capacity for industrial development exists with all alternatives.

Land values of the residential area near the treatment facilities would continue to be adversely affected because of the natural incompatibility between industrial and residential land use. Land use conflicts for retention basins and treatment plants are discussed in the matrix. Limitations on land use within sewer easements will be similar in all alternatives.

An increase in user charges is expected in order to fund the local share of the new facilities. The exact amount is not known at this time.

Public services would be disrupted due to street closings and rerouting of traffic during sewer construction. Recreational areas would be moderately affected by the construction of underground retention basins; however, these impacts are highly site dependent.

Historical and archaeological sites would not be affected by any of the alternatives. However, an archaeological survey of the areas disturbed by the recommended plan would be required before Step II completion.

Public health would be minimally affected by any of the alternatives. Present public health problems have been found related to factors other than sewage collection and treatment.

The Combined Sewer Relief System (Ten-Year Storm Relief System) is the same for all alternatives. The seventeen major sewer relief lines will require 355,790 lineal feet (108,445 m) of sewers with tunnel widths up to 25 feet. One hundred nineteen acres (48 ha) of land would be disturbed in one acre (0.4 ha) parcels for tunneling access every 3000 linear feet.

All four alternatives would have soil erosion and street disturbance impacts from 203,300 linear feet (61,966 m) of open trench sewer construction. Trenches would be dug to accommodate sewer pipe diameters ranging from 10 feet to 15 inches.

The following matrix (Table 5.3-A) presents the differential impacts among the feasible alternatives. Impacts are quantified wherever possible.

### 5.3.3 Summary Ranking of Collection and Treatment Alternatives

Each of the four feasible alternatives is ranked on the basis of environmental impacts, costs, and annual energy consumption.

It is apparent from the matrix that Alternatives D3, C2b, and B2 are all very similar in their environmental impacts. Alternatives D3 and C2b have a slightly less severe impact upon surface water quality because all the treated stormwater is discharged to the Detroit River which has a large dilutional capacity. Treated stormwater in

Alternative B2 is discharged to both the River Rouge and Detroit River. Alternative A2b has a decidedly more severe impact than the other alternatives because effluent will not meet discharge requirements.

When ranked by cost, Alternative B2 and A2b are relatively close, with A2b totalling \$26 million more than the optimization alternative B2. Alternatives C2b and D3 cost \$219 and \$344 million more than Alternative A2b, respectively.

Alternative D3 is the most energy efficient system proposed, due in large part to its use of chemical/physical treatment processes. Alternative A2b is the next most energy efficient system but it does not meet discharge criteria. Alternatives B2 and C2b require $3.95 \times 10^6$ and $5.27 \times 10^6$ gallons more of #2 diesel fuel, respectively, than that required for Alternative A2b.

In summary, Alternative A2b cannot be further considered because it would not be in compliance with PL 92-500. The remaining three alternatives meet water quality standards. Alternative B2 has lower costs than the other two options. Alternatives C2b and D3 counterbalance higher costs with a small improvement in water quality along some points of the River Rouge.

### 5.3.4 Description of Feasible West Arm Alternatives

As noted in the screening, the facilities planning consultant modified the West Arm alternatives and their associated cost figures during July-November, 1977. The four feasible alternatives carried over from screening plus the additional alternative are described briefly and their major features noted in the following discussion. The changes by the facilities planning consultant are briefly described.

- Alternative B

The B Alternative would construct a tunnel from the River Rouge siphons to the DWWTP on the Oakwood Northwest Interceptor. The Hubbell-Baby Creek tunnel connection was eliminated by the facilities planning consultant.

Stormwater retention basins and associated facilities are included in Phases II and III.

- Alternative C

The major feature of Alternative C is a large tunnel sewer from 8 Mile Road to the DWWTP.

Table 5.[illegible]-A

## Environmental Analysis Matrix for Collection and Treatment Systems Alternatives

| Impact Categories | A2b<br>Additional Treatment in Detroit by Other Entities, Do Nothing By Detroit | B2<br>Optimization at Design Capacity |
|---|---|---|
| **SOILS** | | |
| Erosion from Construction | | |
| Treatment: | Erosion from construction on a relatively flat, 140 acre urban site. | Erosion from construction on a relatively flat, 48 acre urban site. |
| Collection: | Erosion from 71 acres excavated in one acre parcels every 3000 ft. for access to 204,250 L.F. of tunnelel sewer. | Erosion from 64 acres excavated in one acre parcels every 3000 ft. for access to 191,750 L.F. of tunneled sewer. |
| **SURFACE WATER** | | |
| Water Quality Parameters | Water quality degradation (1) from surface runoff at construction sites (2) from treatment plant effluent not in compliance with PL 92-500 (3) from urbanization in the region. | Water quality degradation (1) from surface runoff at construction sites (2) from urbanization in the region which would override water quality improvements from compliance with effluent standards. |
| **LAND USE** | | |
| Acquisition of Acreage | | |
| Treatment: | 140 acres (133 acres single family residential; 7 acres institutional). | 48 acres (28.8 acres residential; 9.6 acres recreational; 9.6 acres vacant). |
| Collection: | 165 acres for CSO control (115.5 acres recreational; 18 industrial; 10.5 residential; 21 vacant). 71 acres in 1 acre parcels for access to 212,500 tunneled L.F. Sewer easement for 203,300 L.F. of cut and cover construction. | 165 acres for CSO control (115.5 acres recreational; 18 industrial; 10.5 residential; 21 vacant). 64 acres in 1 acre parcels for access to 191,750 tunneled L.F. Sewer easement for 203,300 L.F. of cut and cover construction. |

Table 5.3-A

(continued)

| C2b Additions to Optimized Plant 2730 Preliminary Capacity | D3 Split Treatment |
|---|---|
| Erosion from construction on a relatively flat, 48 acre urban site.<br>Erosion from 68 acres excavated in 1 acre parcels every 3000 ft. for access to 204,250 L.F. of tunneled sewer. | Erosion from construction on a relatively flat, 48 acre urban site.<br>Erosion from 68 acres excavated in 1 acre parcels every 3000 ft. for access to 204,250 L.F. of tunneled sewer. |
| Water quality degradation (1) from surface runoff at construction sites. (2) from urbanization in the region which would override water quality improvements from compliance with effluent standards. Water quality improvement in some parameters at some stations along River Rouge. | Water quality degradation (1) from surface runoff at construction sites. (2) from urbanization in the region which would override water quality improvements from compliance with effluent standards. Water quality improvement in some parameters at some stations along River Rouge. |
| 48 acres (28.8 acres residential; 9.6 acres recreational; 9.6 acres vacant).<br>367.5 acres for CSO control (300.8 acres recreational; 22.4 industrial; 20 residential; 24 vacant). 68 acres in 1 acre parcels for access to 204,250 tunneled L.F. Sewer easement for 203,300 L.F. of cut and cover construction. | 48 acres (28.8 acres residential; 9.6 acres recreational; 9.6 acres vacant).<br>367.5 acres for CSO control (300.8 acres recreational; 22.4 industrial; 20 residential; 24 vacant). 68 acres in 1 acre parcels for access to 204,250 tunneled L.F. Sewer easement for 203,300 L.F. of cut and cover construction. |

Table 5.3-A

(continued)

| Impact Categories | A2b | B2 |
|---|---|---|
| Land Use Conflicts | | |
| Treatment: | Conners Creek plant would conflict with 133 acres of existing single family residential land use and 7 acres institutional (church) land use. | Facilities would conflict with 28.8 acres residential and 9.6 acres recreational land use. Current land use plan provides for continuation of existing use and does not provide for expansion of treatment plant. |
| Collection: | CSO control facilities would conflict with 10.5 acres residential and 115.5 acres recreational land use. The 71 access sites for tunneled sewers will conflict with current land use patterns. | CSO control facilities would conflict with 10.5 acres residential and 115.5 acres recreational land use. The 64 access sites for tunneled sewers will conflict with current land use patterns. |
| ECONOMY | | |
| Regional income stimulation | 1% increase in total regional income during peak expenditure year 1997. Impacts concentrated in utilities and contract construction industries. | 1-2% increase in total regional income during peak expenditure year 1999. Impacts concentrated in utilities and contract construction industries. |
| SOCIAL STRUCTURE | | |
| Disruption of existing community | Relocation of approximately 500 household units on facility site. | Relocation of 322 household units on 48 acre facility site. |
| Disruption of integral part of community | Park (P. Maheras Field) and several schools adjacent to proposed site. | Relocation of 36 small businesses and 7 institutions (churches, schools) on 48 acre site. |
| ENERGY | | |
| Total equivalent energy needs (BTU/yr.) | $4.52\times10^{12}$ | $5.09\times10^{12}$ |
| Equivalent gallons of #2 diesel fuel | $31.4\times10^{6}$ | $35.35\times10^{6}$ |
| COST (total)<br>Millions of dollars | 1520 | 1494 |

Table 5.3-A

(continued)

| C2b | D3 |
|---|---|
| Facilities would conflict with 28.8 acres residential and 9.6 acres recreational land use. Current land use plan provides for continuation of existing use does not provide for expansion of treatment plant. | Facilities would conflict with 28.8 acres residential and 9.6 acres recreational land use. Current land use plan provides for continuation of existing use does not provide for expansion of treatment plant. |
| CSO control facilities would conflict with 20 acres residential and 300.8 acres recreational land use. The 68 access sites for tunneled sewers will conflict with current land use patterns. | CSO control facilities would conflict with 20 acres residential and 300.8 acres recreational land use. The 68 access sites for tunneled sewers will conflict with current land use patterns. |
| 1-2% increase in total regional income during peak expenditure year 1999. Impacts concentrated in utilities and contract construction industries. | 1-2% increase in total regional income during peak expenditure year 1999. Impacts concentrated in utilities and contract construction industries. |
| Relocation of 322 household units on 48 acre facility site.<br>Relocation of 36 small businesses and 7 institutional (churches, schools) on 48 acre site. | Relocation of 322 household units on 48 acre facility site.<br>Relocation of 36 small businesses and 7 institutional (churches, schools) on 48 acre site. |
| $5.28\times10^{12}$ | $3.37\times10^{12}$ |
| $36.67\times10^{6}$ | $23.41\times10^{6}$ |
| 1739 | 1864 |

- Alternative D

Alternative D is similar to C in that a tunnel sewer from 8 Mile Road to DWWTP would be constructed. The size of the tunnel was reduced for this alternative from that in Alternative C. Stormwater retention basin systems were also included to handle excess stormwater.

- Alternative E

The major feature of Alternative E is a pump station and force main to transport suburban sanitary flows to the DWWTP from 8 Mile Road. Stormwater retention basins and connecting sewers are also included in the proposed construction.

- Alternative H

This alternative is the one proposed by the facilities planning consultant in November, 1977. This plan would construct a tunnel sewer from 8 Mile Road to DWWTP along the same alignment as Alternatives C and D (See Figures 5.2-M, N). Retention basins and collecting sewers for stormwater overflow controls are also included to limit overflows to twelve per year.

### 5.3.5 Impacts of the Feasible Alternatives

Air quality would be impacted insignificantly by the West Arm alternatives if properly operated and maintained. While occasional odors may be emitted, they are not expected to be significant or frequent.

Groundwater would be minimally impacted by any of the alternatives. Little demand for groundwater exists and the future demand is forecasted to decrease (Twenter, 1975).

Future population would not be affected by the alternatives on a regional basis because significant urban area exists for expansion and development. Population location would be insignificantly affected for the same reason. Changes in the location of regional employment would not be discernible because of the large work force. Capacity for industrial development exists in all alternatives.

Land use and land values would be minimally affected due to the alternatives. The differential impacts of the retention basins are presented in the matrix.

The local share of the facilities is expected to increase user charges above presently planned levels. The exact amount of the increase is not known at this time.

Public services may be disrupted due to street closings and rerouting of traffic. Utilities may have service disruptions and emergency services may be disrupted due to construction corridors. Normal construction practices require that alternate routes be developed.

Public health would be minimally improved due to the reduction in CSO. Present public health problems have been attributed to factors other than sewage collection and treatment.

Historical and archaeological sites would not be affected by the construction and operation of any of the alternatives. However, an archaeological survey of the areas to be disturbed by the recommended plan would be required prior to Step II completion.

The environmental ranking matrix (Table 5.3-B) presents an evaluation of the feasible alternative differential impacts. The impacts are quantified were possible and where sufficient data are not availabe, it is so stated.

### 5.3.6 Summary of West Arm Alternative Evaluation

Of the West Arm alternatives, there is no clear cut first choice. The absence of water quality data particularly hampers the evaluation of the alternatives.

The various alternatives all have many adverse impacts due to the high cost and the construction of the facilities as proposed. Alternative C would have somewhat more construction impacts due to the size of the facilities, their location, and the method and sites of construction access. Alternative B would have the least impacts due to the relatively small length of tunnel to be constructed.

The main emphasis of the West Arm is to alleviate water quality degradation from the CSO's. The lack of water quality impact data for the various alternatives makes evaluation of the alternatives difficult at best.

## 5.4 Residuals Management Component Alternatives

### 5.4.1 Sludge Processing Alternatives

Sludge processing includes those unit operations which prepare sludge for disposal. Figure 5.4-A shows the possible options available to the DWSD. The various unit processes must be combined into a feasible treatment system and matched to the appropriate sludge disposal method.

## Table 5.3-B

## Environmental Analysis Matrix for West Arm Alternatives

| Impact Category | Optimization and Retention Basins | Large Tunnel |
|---|---|---|
| **SOILS** | | |
| Erosion from construction | The tunnel spoil may cause erosion at the disposal site(s). The retention basins would cause erosion during construction. | 613,000 cu. yd. of spoil disposal will cause erosion at disposal site(s). |
| **WATER QUALITY** | | |
| Stream Water Quality | Reduction of combined sewer overflows by an estimated 20,000 acre feet/per/year* | Reduction of combined sewer overflows by an estimated 20,000 acre feet/per/year* |
| **SOCIAL STRUCTURE** | | |
| Disruption of existing community tunnels | Minimal impacts due to limited tunelling and location of the tunnel. | Significant impacts due to location, size of tunnel and the 44 access shafts. |
| Retention basins | 9 basins with 570 ac. pt. of storage. | none |
| **EMPLOYMENT** | | |
| Regional income stimulation (based on 30% of construction dollars as labor dollars and $15,000/job/yr.) | $42 million. | $32.7 million. |
| **LAND USE** | | |
| Land Use Conflicts<br>Construction Access | Temporary disturbance to existing parkland. | 44 construction access sites of 1 acre each in residential and commercial land use. |
| Permanent Structures | 9 retention basins will be in parkland, however, they will be below ground and covered. | None in a position to have adverse impacts. |
| **COST** | | |
| Millions of dollars | $140 | $109 |

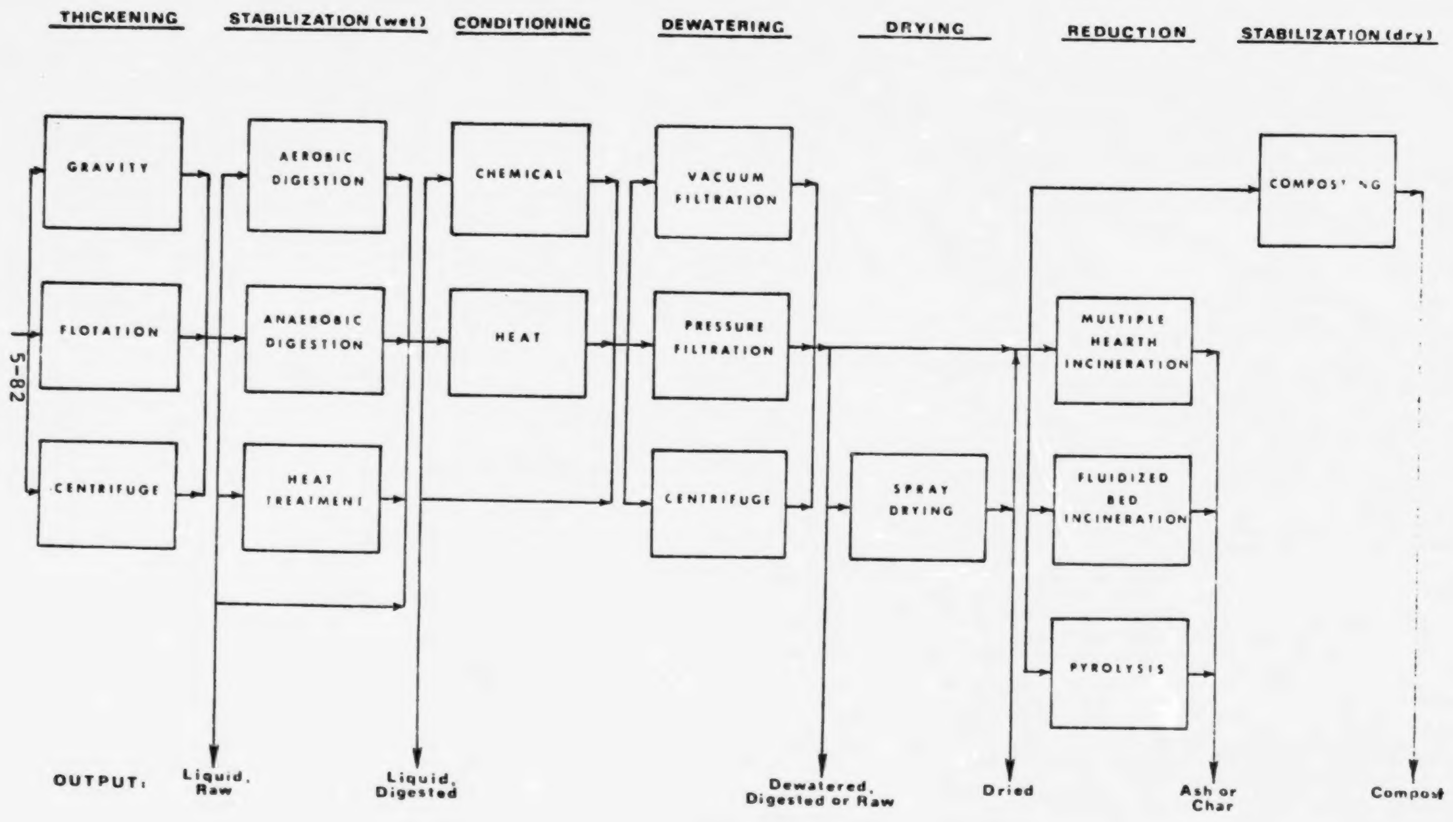
*Facilities Planning Consultant Design Criteria

Table 5.3-B (continued)

| Tunnel and Retention Basins | Force Main, Pump Station and Retention Basins | Tunnel and Retention Basins |
|---|---|---|
| The tunnel spoil may cause erosion at the disposal site(s). The retention basins would cause erosion during construction. | The large force main will cause some erosion due to the open trenches and spoil disposal. The retention basins would cause erosion during construction. | The tunnel spoil may cause erosion at the disposal site(s). The retention basins would cause erosion during construction. |
| Reduction of combined sewer overflows by an estimated 20,000 acre feet per year*. | Reduction of combined sewer overflows by an estimated 20,000 acre feet per year*. | Reduction of combined sewer overflows by an estimated 20,000 acre feet per year*. |
| Significant impacts due to location and size of tunnel - somewhat less than C, same number of access shafts (44). | Moderate impacts due to location and size of force main along major highways. | Significant Impacts due to location and size of tunnel and the 44 access shafts. |
| 9 basins with 440 ac. ft. of storage. | 9 basins with 66.2 ac. ft. of storage. | 9 basins with 66.2 ac. ft. of storage. |
| $38.7 million<br>2,580 jobs | $42 million<br>2,800 jobs | $44.7 million<br>2,980 jobs |
| 44 Construction access sites of 1 acre each in residential and commercial land uses. | Construction access would be along major arterial roads with heavy traffic. | 44 Construction access sites of 1 acre each in residential and commercial land uses. |
| 9 retention basins would be in open space, however they would be below ground and covered. | Pump stations would require little land, the 9 retention basins in open space would be below ground and covered. | 9 retention basins will be in existing open space, however, they would be below ground and covered. |
| $129 | $140 | $149 |

Figure 5.4-A

Sludge Processing Alternatives Considered for Screening


THICKENING
STABILIZATION (wet)
CONDITIONING
DEWATERING
DRYING
REDUCTION
STABILIZATION (dry)
GRAVITY
FLOTATION
CENTRIFUGE
AEROBIC DIGESTION
ANAEROBIC DIGESTION
HEAT TREATMENT
CHEMICAL
HEAT
VACUUM FILTRATION
PRESSURE FILTRATION
CENTRIFUGE
SPRAY DRYING
MULTIPLE HEARTH INCINERATION
FLUIDIZED BED INCINERATION
PYROLYSIS
COMPOSTING
5-82
OUTPUT:
Liquid, Raw
Liquid, Digested
Dewatered, Digested or Raw
Dried
Ash or Char
Compost

This section describes, individually, those unit processes and operations which were considered. Later phases of alternatives analysis will combine these into systems, discuss disposal methods, and consider how they relate to the various alternatives for liquid processes and treatment sites.

### 5.4.1.1 Thickening

Sludge processing reduces the water content but still leaves the sludge in a fluid condition. Possible thickening alternatives are:

- Gravity thickening - Sludge is settled by gravity in a separate thickening tank. The existing DWSD plant uses gravity thickening;
- Flotation thickening - Air bubbles are used to float sludge particles to the surface. A pilot plant for flotation thickening is available at the DWSD plant; and
- Centrifuge thickening - Centrifuges have been used to thicken sludge, where space limitations or sludge characteristics made other methods unfeasible.

The facilities planning consultant (Giffels/Black and Veatch, 1977, Book XII) evaluated sludge thickening both for optimizing the performance of the existing DWWTP and for 50 mgd (189,000 $m^3$/d) modular activated sludge plants.

For the existing DWWTP, the facilities planning consultant (Giffels/Black and Veatch, 1977, Book XII) determined that separate gravity thickening of primary and waste activated sludge could achieve solids concentrations of 10 percent for primary sludge and 3.8 percent for waste activated sludge, with 85 percent solids capture. Three new gravity thickeners were recommended for primary sludge, and two for waste activated sludge; various changes in piping were also recommended to improve process control and allow more operational flexibility.

For activated sludge plants constructed in 50 mgd (189,000 $m^3$/d) modules, the facilities planning consultant (Giffels/Black and Veatch, 1977, Book XII) concluded that gravity thickeners should be used for primary sludge but that flotation thickeners were preferable for waste activated sludge. The reasons cited for the choice of flotation thickeners over gravity thickeners for waste activated sludge were:

- Reliability;
- A thicker product;
- A high solids loading;
- A lower capital cost;
- A better solids capture; and
- Maintenance of sludge in an aerobic condition.

These reasons were considered sufficient to overcome higher operating costs.

Centrifugal thickening was eliminated on the basis of operational problems experienced at existing installations and higher costs compared to flotation thickening ($1,936,000 vs. $1,407,000 for a 50 mgd [189,000 $m^3$/d] installation).

### 5.4.1.2 Stabilization

The principal purposes of stabilization are to make the treated sludge less odorous and putrescible, and to reduce the pathogenic organism content (U.S. EPA, 1974B). Either liquid or dewatered sludge may be stabilized. Depending upon the choice of further processing and the disposal method, stabilization may be optional. The existing DWWTP does not stabilize sludge prior to dewatering and incineration.

Those stabilization processes which were considered are included in the following sections:

- Aerobic digestion is biological degradation of sludge in the presence of oxygen. The sludge is aerated in tanks as in the activated sludge process.

- Anaerobic digestion is liquid phase biological digestion conducted in the absence of oxygen. Typically, 50 percent of the volatile solids in the sludge are converted to methane in a well-run process. This gas can be recovered and used for heating and other energy needs of the plant, though its high sulfur content often requires scrubbing to prevent corrosion of machinery. Methane-forming bacteria have a slow growth rate and are sensitive to operational variables such as temperature, pH, oxygen, and toxic chemicals.

- Heat treatment (pasteurization) may be practiced to both stabilize and condition sludge. Stabilization is accomplished with time-temperature combinations from 70°C and 30 minutes to 170°C and 30 seconds (flash pasteurization).

- Chemical stabilization involves additions of lime in sufficient quantities to maintain a pH of 11.0 to 11.5, which stabilizes the sludge and destroys pathogens.

- Composting is aerobic, solid phase digestion, using a carbon carrier such as wood chips, and is conducted in three steps. The first step is aeration, where aerobic digestion increases the temperature and destroys most pathogens. The second phase, windrowing and storage, continues the destruction of pathogens and volatile solids. Drying is a final step and aids future handling.

DWWTP does not use sludge stabilization before incineration. The performance review supported this choice by concluding that raw sludge could be adequately conditioned for dewatering by other means. However, if processing/disposal alternatives are considered which do not include reduction, stabilization may be necessary. For example, raw sludge may not be used for land application (MDNR, 1976) (Blakeslee, P.A., Personal Communication, 1978). Therefore, stabilization alternatives are evaluated in 50 mgd (189,000 $m^3/d$) modules both for the existing facilities and for new facilities at other sites (see Section 5.5).

### 5.4.1.3 Conditioning

Conditioning is a processing step in which the total sludge and water complex is prepared for dewatering. Principal methods for conditioning are included in the following sections:

- Chemical conditioning to reduce the bound water and to increase filterability is the most common process used. Chemicals used include inorganic multi-valent ions, such as ferric iron or aluminum, or organic polymers, and may be accompanied by "elutriation" (washing) to remove interfering soluble substances such as carbonates and bicarbonates. Large amounts of ash, usually recycled from incinerators, are sometimes used to condition sludge for pressure filtration.

- Low pressure thermal conditioning is a process involving heating the sludge mass to 300-500° F at 150-400 psi. This heating disinfects and solubilizes some of the volatile solids and may also oxidize some of the solids if operated at higher temperatures and pressures. The "cooking liquor" remaining after settling/dewatering is a rather putrescible liquid containing soluble organic carbon compounds, amino acids and ammonia. If further dewatering is practiced, this "liquor" must be stabilized either by recycle to main stream aeration or to separate treatment. The recycle of this liquor results in increasing solids and organic loading throughout the plant. Process inputs consist of pumping energy and thermal energy, which may be derived from incinerator heat recovery.

The existing DWWTP uses polymers to condition the sludge and achieves satisfactory dewatering. The facilities planning consultant also recommended pilot studies of adding powdered coal to the sludge to further improve dewatering and to raise the heat value. Thus, coal would replace some of the natural gas which is presently burned during incineration.

No specific recommendations were made for sludge conditioning at any additional wastewater treatment facilities, as it was believed that this should be determined on a case by case basis following pilot studies. It was assumed, however, that some form of chemical conditioning would be needed.

#### 5.4.1.4 Dewatering

Dewatering changes the sludge from a liquid into a solid or semi-solid state (20+ percent solids content). This greatly reduces the weight of the sludge and increases its net heat value. Processes available for dewatering are included in the following sections:

- Vacuum filtration occurs when the solids are picked up by vacuum on a moving belt, with the liquid fraction passing through and being recycled. Before the filter, some form of conditioning is necessary for economical operation. For proper operation, the feed solids should be conditioned and thickened, because feed solids, in part, determine solids content of the filter cake.

- Pressure filtration uses a high positive pressure to force the liquid through the filter media. In a cyclic operation of about 2 hours, sludge is pumped between plates covered with the filter media, the liquid seeps through, and the plates are separated for solids removal. Recent improvements in filter media and the development of automatic cake removal methods have revived interest in pressure filtration. Filter presses are capable of achieving high cake solids concentrations of 30 to 50 percent.

- Centrifugation using solid bowl at low speeds is a common dewatering alternative. Properly designed centrifuges, fed heat-conditioned sludge, can achieve up to 85 percent solids capture and 40 percent cake solids without additional chemicals.

- Sand drying beds are a method of dewatering applicable to smaller plants or remote areas. It involves spreading the sludge in a layer over a base of sand and allowing the drying to be performed through evaporation and drainage.

### 5.4.1.5 Drying

Drying removes most of the bound water from a sludge without oxidizing the organic solids. Since the organic material remains, the dried sludge can be used as a soil conditioner, or can be burned in an incinerator. Drying requires large amounts of energy to evaporate the water in the sludge; incineration with heat recycle can supply part of this energy, since dried sludge has a high heat value for incineration.

Complete drying of sludge would require approximately 1.4 x $10^7$ BTU per ton of dry solids (3.3 x $10^7$ kg/kg) at a cost of about $82 for fuel alone per ton. As sludges with equally desirable disposal properties (e.g. compost) can be produced for less cost with less energy, drying was not considered practical.

### 5.4.1.6 Reduction

Reduction processes not only remove most of the water from sludge, but destroy or alter the volatile solids. The chief purpose of reduction is to reduce the sludge volume for disposal. Several reduction processes were evaluated:

- Multiple hearth incinerators, used at the existing DWWTP, consist of a number of annular hearths stacked vertically inside a refractory lined within a cylindrical steel shell. Sludge is fed into the top hearth and raked by rabble arms into openings through which it falls to succeeding hearths.

The furnace operates in three zones. In the top zone, wet sludge is dried by hot exhaust gases; the gases are, in turn, cooled by the sludge. In the second, or burning zone, the volatile material in the sludge ignites and reaches a temperature of 1,400 to 1,600°F. As the burned sludge descends to the lower zone, the hot ash is cooled by the incoming combustion air.

The gross heat required for incineration depends largely upon the amount of water evaporated (water has a high heat of evaporation); and for this reason it is important that the sludge be as dry as possible. Much of this heat can be supplied by combustion of volatile solids in the sludge itself; any remaining heat must come from auxiliary fuel.

The existing Complex I and Complex II incinerators at the DWWTP were studied in detail by the facilities planning consultant to see how their performance could be improved. After initial investigations of the capacity and performance of the existing incinerators, it also appeared worthwhile to re-evaluate the decisions to install tall stacks and to build Complex III incinerators as designed. These major types of modifications were considered:

- Complete PC-400 modifications to Complex I, including afterburners and venturi scrubbers;
- Install afterburners and venturi scrubbers on Complex II, similar to PC-400;
- Modify the combustion air flow to reduce auxiliary fuel consumption. These modifications would entail recycling gases from the drying (upper) hearths to the burning (middle) hearths, and exhausting gases from the burning hearths. The hot exit gases would enter a heat exchanger to heat incoming combustion air. This eliminates the need for an afterburner and reduces excess air requirements;
- Don't build Complex III; and
- Build Complex III with electrostatic precipitators instead of venturi scrubbers.

All of these modifications would affect the total capacity of the incinerators, their auxiliary fuel consumption, and their air pollution emissions and dispersion. Detailed technical discussions can be found in Giffels/Black and Veatch, 1977, Book XII.

- Fluidized bed incineration utilizes a bed of sand maintained in a fluid suspension by the upward flow of combustion air. Drying and combustion of sludge take place in the same chamber. The heat retention ability of the large mass of sand serves to smooth out heat fluctuations and helps provide for efficient burning.

- Pyrolysis is controlled combustion in the absence of sufficient air to burn the sludge. The process requires raising the sludge to a temperature at which the volatile matter will distill, leaving carbon and inert material behind. The volatile gases can be recovered and the char may have commercial value as a fuel. Pyrolysis produces useful by-products and reduces air pollution.

### 5.4.2 Sludge Disposal Alternatives

The environmental impacts of a wastewater treatment plant are heavily dependent upon the choice of a sludge disposal method. Processing and disposal cannot be completely separated since processing changes sludge characteristics which influence the choice of a disposal method.

A number of sludge disposal methods were considered. This section will describe these alternatives and show how they relate to sludge characteristics.

### 5.4.2.1 Land Application

Sewage sludge can be applied to land to serve as a soil conditioner and nutrient source. Many different application techniques are in use today. These techniques involve some form of spreading, spraying, or subsurface injection. Depending upon the type of sludge, incorporation into the soil may be necessary.

The types of sludges which were dealt with, because they would be the products of the feasible sludge processing alternatives are:

- Digested liquid sludge;
- Digested dewatered sludge;
- Composted sludge; and
- Incinerator ash/char.

Design of a land application scheme must consider such matters as nutrient balances, heavy metal accumulation, pathogen control, water budget, soil characteristics, drainage, topography, application technique and farming practices. When all these factors are properly considered, land application can be a safe, environmentally sound and beneficial means of sludge disposal.

The economics of land application of sludge depend heavily upon land values, fertilizer costs, crop revenues, spreading costs and hauling costs, as well as any additional sludge processing necessitated by land application. The energy balance must weigh the energy used in processing, hauling, and spreading the relatively bulky sludge against the energy needed to produce commercial fertilizers.

Sludge can be spread on croplands such as corn or sod, as well as forests and recreational land, provided that the land meets certain minimum requirements for drainage, etc. Economy of scale favors spreading on large tracts of land; usually such acreage is found outside of suburban areas. Land can be purchased or leased, or the sludge could simply be given to the farmer. Some degree of monitoring and control is desirable to ensure proper use of the sludge.

For public health reasons, the State of Michigan prohibits land application of raw sanitary sewage sludge; therefore, only dried or stabilized sludge will be considered further.

Ash and char have little nutrient value; land application of this type of sludge would essentially be disposal, not reuse. However, spreading of ash or char on non-food chain recreational lands was considered by the facilities planning consultant.

Implementation of a land application scheme can become a difficult problem, as sludge often has to be transported across political boundaries. These political factors cannot be ignored.

- Application Methods

The characteristics of the sludge restrict the application methods that can be used. By sludge category, the methods addressed are:

- Stabilized liquid sludge
    - Spraying;
    - Irrigation by flooding or overland flow; and
    - Subsurface injection.
- Stabilized dewatered sludge
    - Spreading and plowing; and
    - Reslurry for liquid disposal.
- Composted sludge
    - Spreading and plowing; and
    - Surface spreading.

Liquid sludge is normally at a solids concentration of 2-5 percent. At this concentration, spraying from a sprayhead or tank truck is possible. The sprayhead method, from a pipeline, has the lowest handling and maintenance requirements, but has less flexibility for disposal sites. Tank trucks provide maximum mobility but have high operator and maintenance requirements. Irrigation by flooding or overland flow is sometimes used. Flooding has site requirements which are difficult to meet for large amounts of land. Overland flow requires strict runoff control, and is again difficult to implement with the lands that are available. Subsurface injection is used on tillable land by injecting sludge into a channel formed by a tilling tool.

Dewatered sludge is generally either distributed from a truck-mounted spreader or it is piled and spread by a bulldozer or grader. The spreader may be a modified manure spreader, as sludge is not quite the same consistency as manure. When sludge is piled or placed in windrows by dump trucks, a bulldozer or grader is then required to distribute the sludge. Of these methods, the manure spreader requires less machinery, less operator time, results in a more even distribution. After the dewatered sludge is spread, it must be plowed into the soil surface to gain the maximum nutrient benefits, reduce contamination of surface runoff, reduce odors, and control pathogens. The need for plowing dewatered sludge into the soil precludes its use in forest applications.

The purpose of reslurrying sludge and then using a liquid disposal method is to gain transport ease. However, the process of adding water to an already dewatered sludge wastes the energy used for dewatering, the energy used in reslurrying, and does not provide any benefits over pipeline transport of a liquid sludge other than flexibility.

The aerobic digestion that occurs during composting reduces pathogen and odor problems. Spread on the soil surface in the same manner as dewatered sludge, it is not necessary to plow compost into the soil. It can be left as a top-dressing with no additional adverse impacts. This allows a wider range of disposal sites.

- Regulations

Although land application has been used for years, there is conflicting evidence as to the impacts of sludge on land resources and crops. As more becomes known about the effects of heavy metals and persistent chemicals on humans, the greater the necessity becomes to understand what happens to these constituents when sludge is applied to land. Consequently, complete guidelines have not been issued for sludge land application.

In addition, a publication from the Ohio Agricultural Research and Development Center presents the existing techniques used for land application (Knezek and Miller, 1976). This publication presents guidelines for heavy metals and nutrient content of sludge being applied to land. Until EPA and the MDNR are able to present their own guidelines, this report is being used to assist evaluation of land application systems (D. Ehorn, Personal Communication, 1977). The amount of heavy metals that can be applied is based on the cation exchange capacity of the soil, and is a total amount that may be applied over the life of the project. The nitrogen limitations that govern the amount of sludge applied annually is based on the nitrogen uptake of the crop, the amount of organic and inorganic nitrogen in the sludge, and an expected mineralization rate of the organic nitrogen in the soil and sludge.

#### 5.4.2.2 Retail Sales

In the proper form, sludge could be packaged and sold through retail outlets to individual consumers. In a suburban market area, the majority of the sludge would ultimately be spread on gardens, lawns, or other ornamental vegetation. A retail sales program can achieve sludge spreading on land such as small lawns where it would be uneconomical for a municipal program to spread sludge.

In the retail sales market, sludge must compete directly with commercial fertilizers and soil conditioners. Only dried sludge and composted sludge have characteristics that make them competitive for retail sales. Liquid and dewatered stabilized sludge will, therefore, be considered only for organized land application alternatives, not for retail sales.

#### 5.4.2.3 Sanitary Landfill

In a sanitary landfill operation, sludge is systematically deposited in "cells" and covered with soil. Design of a landfill site must account for gas movement within the landfill, leachate control and groundwater protection, as well as proper placement of sludge in the landfill. A sanitary landfill is distinguished from an open dump by regular covering of the deposited material. This covering substantially reduces odor and leaching problems and facilitates pest control. Open dumps are not considered an acceptable disposal method.

Any type of dewatered or dried sludge can be placed in a sanitary landfill. These alternatives will be evaluated in Section 5.5.

#### 5.4.2.4 Trenching

Trenching is a disposal method for sludges which is similar to a sanitary landfill operation. A backhoe is used to dig a trench, sludge is then deposited in the trench, and the trench is covered. Trenching will be evaluated in Section 5.5.

#### 5.4.2.5 Remote Drying Lagoons

Although their large land area requirements make sludge drying beds impractical for use at plant sites in densely developed areas, it would be possible to transport liquid sludge to remote drying lagoons.

The facilities planning consultant proposed an alternative whereby sludge would be transported by pipeline to a remote site. The sludge would be stabilized and then deposited in large drying lagoons. The water in the sludge would evaporate or seep into the ground, depending upon weather conditions. This alternative is evaluated in Section 5.5.

#### 5.4.2.6 Industrial Reuse

The possibility of finding uses for sludge among the many industries of the Detroit area was examined. Industrial applications included use of sludge as a fuel or as a construction material. Sludge could be combined with coal or oil and fed to a commercial power plant to generate electricity. Char produced during pyrolysis could be used either in a power boiler or in coking ovens. Although none of these alternatives would actually solve the problem of ultimate disposal of ash, they would contribute to recovery of the energy value of sludge and they will be considered in Section 5.5.

Another alternative considered in the screening will be to use incinerator ash as a construction material, such as an additive to cement manufacturing.

#### 5.4.2.7 Land Reclamation

Sewage sludge has been shown to be of value in restoring strip mines and other places that have been denuded of top soil (Sopper, 1976). The sludge is used to add organic matter and nutrients and to improve the moisture retention properties of mine spoils. This aids in establishing a vegetative cover and reduces acid mine drainage and erosion.

Land reclamation differs from land application in that reclamation is usally a one-time application, often accompanied by regrading. As the areas to be reclaimed are often lacking in nutrients, higher sludge loading rates are utilized than for croplands. Heavy metals are also of somewhat less concern, as reclaimed areas are generally not used for agriculture.

Land reclamation alternatives would require long hauling distances and would have to overcome numerous political and jurisdictional problems. However, because of potential benefits, land reclamation was investigated in more detail in the screening for liquid and dewatered stabilized sludge, dried sludge and compost.

The facilities planning consultant also considered the possibility of disposing incinerator ash in coffer dammed island areas of Lake St. Clair and Lake Erie.

### 5.4.2.8 Other Considerations

- Co-Dispcsal

Co-disposal of sludge with other wastes could offer economy of scale and allow a single agency to dispose of several wastes.

In burning coal to generate electricity, Detroit Edison produces large amounts of fly ash. Co-disposal of fly ash and incinerator sludge was evaluated.

Co-disposal of sludge with municipal refuse in a sanitary landfill was also considered. For dewatered sludge, addition of refuse would improve mechanical properties and facilitate handling.

- Co-Incineration

Dewatered sludge, dried sludge or composted sludge could be mixed with municipal refuse and incinerated. Energy recovery could generate steam or electricity. Municipal refuse has a moderately high heat value and burns easily; this could help overcome some of the technical problems encountered in burning sludge alone.

- Export from the Region

If a suitable buyer could be found, sludge could be exported from the Great Lakes region. This possibility was evaluated by the facilities planning consultant. Any importer of sludge would, in effect, also have to choose one of the disposal methods described previously.

- Contract Hauling

Incinerator ash is presently hauled away by contractors to various sites, not all of which are known. This alternative was considered as "no action." It is similar to sanitary landfilling, except DWSD has no control over the landfill.

## 5.4.3 Treatment and Disposal of Other Residuals

### 5.4.3.1 Grit and Screenings

Existing procedures call for grit and screenings to be deposited in containers and hauled by truck to a sanitary landfill. The alternative of on-site reduction prior to final disposal was also considered.

### 5.4.3.2 Grease and Skimmings

Alternatives considered for grease and skimmings included:

- Rehabilitation and improvement of the existing system; and
- Combining grease and skimmings with sludge.

## 5.5 Screening of Residuals Management Alternatives

### 5.5.1 Sludge Processing Alternatives

The sludge processing components will be evaluated on environmental, cost, and engineering criteria. The components which are found most suitable for Detroit's situation will be arranged in feasible processing systems for continued screening in the evaluation phase.

#### 5.5.1.1 Thickening

The facilities planning consultant (Giffels/Black and Veatch, 1977, Book XII) evaluated the sludge thickening process for optimizing the performance of the existing DWWTP, and for 50 mgd (189,000 $m^3/d$) modular activated sludge plants (see Section 5.4.1.1).

For the existing DWWTP, continuation of gravity thickeners for primary and waste activated sludge could achieve desired effect.

Activated sludge plants constructed in 50 mgd modules should preferably be equipped with gravity thickeners for primary sludge and flotation thickeners for waste activated sludge.

#### 5.5.1.2 Stabilization

Sludge stabilization is an unnecessary step if incineration is utilized for reduction. This is the present situation at the DWWTP. However, in order to investigate alternatives to incineration, the sludge processing system must be capable of proper sludge preparation. Therefore, possible methods of stabilization (as presented in Section 5.4) are evaluated here.

Table 5.5-A compares the costs, environmental impacts, and engineering characteristics of composting, aerobic digestion, heat treatment, and lime stabilization.

## Table 5.5-A

Comparison of Sludge Stabilization Alternatives for 50 mgd (189,000 $m^3$/day) Modules

| Alternative | Composting | Aerobic Digestion | Anaerobic Digestion | Heat Treatment (Pasteurization) | Lime Stabilization |
|---|---|---|---|---|---|
| Cost of a 50 mgd module, $/ton, dryweight | $33/ton* | $18.12/ton** | $10.06/ton** | No information | $22/ton** |
| Energy requirements | Low | Very High | Produces methane gas for energy recovery: net gain in useful energy. | Very high, unless recycled incinerator heat is used. | High |
| Characteristics of stabilized sludge | High quality sludge that can be sold in retail market as a soil conditioner, or used for land application. Sludge stores well. | Good quality sludge which dewaters well, is odorless and suitable for land application. | Good quality sludge which dewaters well and is suitable for land application. | Sludge is suitable for land application. | Sludge is suitable for land application. |
| Operational characteristics | Insensitive to toxic chemicals and shock loading. | Mildly sensitive to toxic chemicals and shock loadings. | Very sensitive to toxic chemicals and shock loadings. | Insensitive to toxic chemicals or shock loadings. | Insensitive to toxic chemicals or shock loadings. |
| | Can be disrupted temporarily by rainfall. | | Produces recycle stream with high COD. | Produces recycle stream with very high COD. | Requires large amounts of chemicals. |
| Environmental Impacts | Land required=20 acres (8.1 ha) | Land required. | Land required. | Land required. | Land required. |
| | | | Potential for odors if not operated correctly. | May present odor problems if land applied. | |

* Ref: Collacicco (1976).
** Giffels/Black and Veatch, (1977)

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Anaerobic digestion was not a suitable stabilization process for the DWWTP because of its sensitivity to toxic chemicals and shock loadings. Aerobic digestion, while technically feasible, was rejected on the basis of its high energy requirements. Likewise, high energy consumption was the reason for rejecting heat stabilization, since it was assumed that incinerators would not be used with a stabilization process. Both lime stabilization and compost stabilization are technically feasible and have low to moderate energy requirements.

The higher costs of composting (see Table 5.5-A) are offset by the higher quality compost which is desirable as a soil conditioner. Any land application program for DWWTP sludge will require extensive disposal sites (approximately 80,000 acres or 32,000 ha). A sludge that is readily acceptable by private farmers and landowners could significantly reduce the city's land need. Lime stabilization compared favorably to composting but disposal considerations favored selection of composting.

For new facilities constructed at other sites, the facilities planning consultant (Giffels/Black and Veatch, 1977, Book XII) determined that anaerobic digestion was the preferred stabilization alternative, since the sensitivity of the process to toxic and shock loadings was not likely to be a problem for suburban plants serving primarily residential areas on separate sewers. This choice, however, was academic, as the facilities planning consultant (Giffels/Black and Veatch, 1977, Book XII) then assumed that these plants would use incineration, and would not need stabilization.

### 5.5.1.3 Conditioning

Currently DWWTP uses polymers to condition sludge and has been achieving satisfactory results. Therefore, the facilities planning consultant recommends continuation of this process. (See Section 5.4).

No specific recommendations were made for sludge conditioning at any additional wastewater treatment facilities, but it is assumed that some form of chemical conditioning would be needed.

### 5.5.1.4 Dewatering

The performance evaluation of the existing DWWTP concluded that dewatering facilities equivalent in capacity to four additional vacuum filters should be added to Complex II, but that vacuum filters for Complex III were not needed in the immediate future. This assumed a 5 lb./sq.ft./hr. (24 kg/$m^2$.H) loading rate and 85 percent unit availability. For the year 2000, it was assumed that 10 filters of 750 sq.ft. (70 $m^2$) would be needed for Complex III to achieve an overall loading rate of 4 lb./sq.ft./hr. (20 kg/$m^2$.h) and 80 percent unit availability. Modifications in sludge cake conveying are necessary to achieve these unit availability rates.

The facilities planning consultant (Giffels/Black and Veatch, 1977, Book XII) emphasizes that vacuum filters generally perform satisfactory for DWWTP in dewatering sludge and achieving high solids concentrations when properly operated and maintained. Therefore, alternative onsite dewatering methods were not analyzed in detail and priority in future dewatering studies should be given to improved sludge conditioning prior to vacuum filtration.

One additional dewatering alternative was considered in connection with sludge disposal alternatives for the DWWTP: Sludge drying beds located at a remote site.

In the drying beds, water in the sludge will be lost through evaporation, or seepage to groundwater. Evaporation losses will then be approximately equal to pan evaporation rates less rainfall, and would account for a net average loss of 0.1 mgd (400 $m^3$/day) or 2 percent of the sludge water content. The remainder of the water can be expected to eventually seep into the groundwater. Assuming an inorganic nitrogen fraction of 0.5 percent dry weight in the sludge, and neglecting any mineralization of organic nitrogen, the inorganic nitrogen content of the leachate could approach 200 mg/l. Without extensive analysis, it is not possible to determine the exact impacts of this leachate. It can be concluded, however, that this alternative has at least the potential to create severe groundwater pollution from ammonia and/or nitrate nitrogen.

For additional wastewater treatment facilities, the facilities planning consultant assumed that vacuum filters would be the selected method of dewatering for developing costs. However, filter presses appeared to offer slightly lower costs for a 50 mgd (189,000 $m^3$/d) installation with dewatering of unstabilized sludge, the estimated present worth of filter presses was $2,930,200 vs. $3,518,200 for vacuum filters. This assumption did not significantly affect the economics of system alternatives.

#### 5.5.1.5 Drying

As pointed out in Section 5.4, sludge drying was considered impractical due to the high cost and large energy requirements.

#### 5.5.1.6 Reduction

- Multiple Hearth Incineration

Table 5.5-B presents a summary comparison of nine possible multiple hearth incineration alternatives. "Firm capacity" was determined by assuming one unit of each complex is not functional, a second is available only 25 percent of the time, and the others are operating at 90 percent of their capacity. Auxiliary fuel consumption is based on present performance, with the effects of afterburners or combustion modifications superimposed; the incinerators presently use natural gas, but it was assumed that only #2 fuel would be available in the future, at 60 cents per gallon. All particulate concentrations are for an input of 1064 dry tons per day (965,000 kg/d) of dewatered sludge, i.e. year 2000 loadings at 1000 mgd (3,785,000 $m^3$/d). Annual costs include amortized capital, labor, fuel, electricity, and other O&M costs for incineration only, and do not include dewatering or ash disposal costs, which are the same for all alternatives.

All alternatives, except "no action", will comply with the annual average limits for particulates, but numbers 1, 2, 3, and 5 will exceed the 24 hour peak concentration. Therefore, Alternatives 1, 2, and 3 were eliminated. Alternative 5 however, is mandated construction (e.g., a "given"). Not only will this alternative not meet an air quality limit, but it is one of the more costly alternatives. Although the mandated construction will be evaluated later, it appears justifiable to consider at least another incineration alternative along with mandated construction.

Of the remaining alternatives, only 6, 7, and 9 can meet the 1064 dry ton per day (965,000 kg/d) capacity requirement (eliminating Alternatives 4 and 8), and Alternative 7 was selected for further evaluations on the basis of lower costs, lower energy requirements, and lesser particulate emissions. The low costs of Alternative 9, however, suggests a third possibility: a "hybrid" alternative, whereby 1051 tons per day (953,000 kg/d) would be incinerated and the remaining sludge disposed of by other means such as composting with land application.

Table 5.5-B

Comparison of Sludge Incineration Alternatives

| Alternative | Complex I | Complex II | Complex III | Firm Capacity, tpd Dry Weight @27.7% Solids[3] | Auxiliary Fuel Consumption gal/yr No. 2 Fuel Oil @ 1,064 tpd (dry) | Air Quality Impact, ug/m$^3$ Particulates @ 1,064 tpd | | Annual Cost @ 1,064 tpd |
|---|---|---|---|---|---|---|---|---|
| | | | | | | 24 Hr Peak[4] | Annual Average[5] | |
| 1[1] | Existing | Existing | Not constructed | 1,050 | 16,900,000 | 7,650 | 168 | $14,390,000 |
| 2 | PC-400 | Existing | Not constructed | 1,020 | 20,800,000 | 1,820 | 52 | $18,030,000 |
| 3 | PC-400 and tall stacks | Existing and tall stacks | Not constructed | 1,020 | 20,800,000 | 1,450 | 26 | $18,250,000 |
| 4 | PC-400 | PC-400 type modifications (afterburner and venturi scrubber) | Not constructed | 961 | 29,000,000 | 13 | 0.3 | $23,200,000 |
| 5[2] | PC-400 and tall stacks | Existing and tall stacks | As designed | 1,714 | 19,100,000 | 870 | 16 | $22,140,000 |
| 6 | PC-400 | PC-400 type modifications | As designed | 1,656 | 23,900,000 | 12 | 0.1 | $25,100,000 |
| 7 | Combustion air modifications and PC-400 type scrubbers | Combustion air modifications and PC-400 type scrubbers | Combustion air modifications and scrubber as designed | 1,745 | 51,700 | 9 | 0.1 | $14,600,000 |
| 8 | Combustion air modifications and PC-400 type scrubbers | Combustion air modifications and PC-400 type scrubbers | Combustion air modifications with electrostatic precipitator | 1,745 | 51,700 | 66 | 1.3 | $14,600,000 |
| 9 | Combustion air modifications and PC-400 type scrubbers | Combustion air modifications and PC-400 type scrubbers | Not constructed | 1,051 | 51,700 | 8 | 0.2 | $ 9,670,000 |

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[1] "No Action" alternative

[2] Mandated Construction

[3] The 1980 required capacity is 847 tpd; the year 2000 required capacity is 1,064 tpd

[4] Standard is 260 ug/m$^3$.

[5] Standard is 75 ug/m$^3$.

In summary, three incineration alternatives will be carried forward for further analysis in the evaluation phase:

- Alternative 5 - Mandated construction: PC-400 improvements to Complex I, tall stacks, and construction of Complex III as designed;
- Alternative 7 - Combustion air modifications to all three complexes: PC-400 type scrubbers on Complexes I and II, and Complex III scrubbers as designed; and
- Alternative 9 - Combustion air modifications to Complexes I and II: PC-400 type scrubbers on Complexes I and II, and no construction of Complex III. Additional capacity will be provided by a composting site followed by land application.

- Fluidized Bed Incineration

The facilities planning consultant (Giffels/Black and Veatch, 1977, Book XII) in reviewing the merits of fluidized bed incineration, listed the following advantages and disadvantages:

Advantages
- No moving parts;
- Requires little floor space;
- Small refractory surface aids start-up; and
- Burns sludge in a single chamber for better control.

Disadvantages
- No large-scale installations in operation with sludge; and
- Need to maintain a uniform gas stream from the sand bed complicates design of large units.

Although the potential advantages were recognized, the facilities planning consultant (Giffels/Black and Veatch, 1977, Book XII) concluded that there was still development work to be done before large scale units burning sewage sludge could be properly designed.

- Pyrolysis

The facilities planning consultant (Giffels/Black and Veatch, 1977, Book XII) reviewed the state-of-the-art of pyrolysis of sewage sludge and determined the following:

"Although more research must be done regarding pyrolysis of sewage sludge before it can be considered a proven technology, some general observations can be made. Possible advantages to using pyrolysis or starved-air incineration include:

- A savings in auxiliary fuel costs stemming from the fact that the products of pyrolysis (gas, oil, and carbon char) can be used to supplement the auxiliary fuel requirements;
- The carbon char, if properly activated, may be used in the wastewater treatment operations;
- The fuel products can be stored allowing flexibility in their use;
- The ash residue is a satisfactory fill material that represents a significant reduction in sludge volume; and
- A savings in capital and operating costs of air pollution control due to cleaner exhaust gases and a reduction in exhaust air volume.

"Possible disadvantages to this method of sludge disposal (sic) include:

- To be economically competitive with normal incineration, the solids content of the sludge feed must be at least 40% which requires additional processing before the sludge is pyrolyzed; and
- If the pyrolysis gases are stored, they must be cleaned first and in cleaning gases, oil, and tar vapors along with water, vapor will condense. This may result in water pollution if the condensable oils and tars are water soluble.

"While research to date has shown pyrolysis and starved-air incineration to be a possible means of sewage sludge disposal, it will not necessarily be feasible in all instances and must, therefore, be studied on a case by case basis. The feasibility of using pyrolysis in a sludge disposal application will depend upon the quality of the sludge feed, the value of the carbon char byproduct as either a useable item in the plant operations or as a marketable item, the amount of savings in fuel costs realized by the plant, and the results of an economic analysis of the total plant operations.

"The feasibility of using pyrolysis at the DWWTP for sewage sludge disposal can only be determined after pilot plant studies have been conducted and detailed energy usage and economic analyses have been completed on the facilities. While pyrolysis may prove to cause a reduction in auxiliary fuel usage and air pollution control requirements, the relative monetary savings may be insignificant. This will depend on the extent of the reduction and the cost and availability of fuel in the Detroit area at both the present time and in the future...

"While pyrolysis may prove to be an effective, economically feasible method of sewage sludge disposal at the DWWTP, it cannot be recommended for use at this time. The main reason for this is the fact that at the present time, pyrolysis of sewage sludge can only be considered an experimental process needing much more research to determine when its use will be most advantageous." (Giffels/Black and Veatch, 1977, Book XII).

Although full-scale conversion to pyrolysis is not considered feasible, due to the many technical uncertainties, the potential advantages are sufficiently great to evaluate installation of a pilot unit. A pyrolysis alternative using the Redker-Young process is described and analyzed in the evaluation section. This alternative assumes that a 100 tpd (91,000 kg/d) pilot pyrolysis unit would be constructed, and that, if successful, additional larger units would be installed.

#### 5.5.1.7 Processing and Disposal of Other Residuals

The facilities planning consultant (Giffels/Black and Veatch, 1977, Book XII) reviewed the operational history of the existing water grate scum and grease incinerator, and concluded that most of the problems experienced by this unit were due to relatively minor deficiencies rather than inherent design weaknesses. It was recommended that the incinerator be rehabilitated and tested further before deciding whether it should be replaced.

### 5.5.2 Final Sludge Disposal Alternatives

A key consideration to the sludge disposal planning process is the characteristics and quantities of sludge to be produced. Table 5.5-C lists the products and in their anticipated quantities from the previously discussed sludge processing alternatives.

Final sludge disposal techniques are generally dictated by the composition of the waste material. Table 5.5-D lists the disposal techniques which will be evaluated in this section, and illustrates the necessary sludge characteristics for optimal operation.

#### 5.5.2.1 Land Application

Land application of sludge, if properly managed, can provide significant benefits to land resources and provide a cost-effective disposal system, without resulting in environmental damages or health hazards. The effectiveness of a land application system depends on the quality of

## Table 5.5-C

## Expected Daily Sludge Production

| Sludge Characteristics | Daily Sludge Production, tons/day (kg/day), dry weight Year 1980 | Year 2000 |
|---|---|---|
| Liquid, Raw | 847 | 1,064 |
| Liquid, Digested | 616 | 772 |
| Liquid, Lime Stabilized | 1,060 | 1,330 |
| Dewatered, Raw | 847 | 1,064 |
| Dewatered, Digested | 616 | 772 |
| Dewatered, Lime Stabilized | 1,060 | 1,330 |
| Dried | 847 | 1,064 |
| Ash | 431 | 585 |
| Char | 431 | 585 |
| Compost | 1,388 | 1,744 |

Table 5.5-D

Sludge Disposal Alternatives for Screening

| | Liquid, Raw | Liquid, Stabilized | Dewatered, Raw | Dewatered, Stabilized | Dried | Ash | Char | Compost |
|---|---|---|---|---|---|---|---|---|
| Land Application | | | | | | | | |
| Cropland, Food-Chain | | X | | X | X | | | X |
| Non-Food Chain Lands | | X | | X | X | X | | X |
| Forests | | X | | X | X | | | X |
| Retail Sales | | | | | X | | | X |
| Sanitary Landfill | | | X | X | X | X | X | X |
| Trenching | X | X | | | | | | |
| Remote Drying Lagoons | | X | | | | | | |
| Industrial Re-Use | | | | | | | | |
| Fuel | | | X | X | X | | X | X |
| Other | | | | | | X | | |
| Land Reclamation | | | | | | | | |
| Mines or Quarries | | X | | X | X | | | X |
| Islands in Lakes | | | | | | X | | |
| Co-Disposal | | | | | | | | |
| With Fly Ash | | | | | | X | X | |
| With Municipal Refuse | | | X | X | X | | | X |
| Co-Incineration | | | | | | | | |
| With Municipal Refuse | | | X | X | X | | | X |
| Export from Region | X | X | X | X | X | X | X | X |
| Contract Hauling | | | | | | X | | |

the sludge, the location and type of disposal site, and the degree of management control exerted. This section will describe the possible land application systems that could be used, based on the projected quality of Detroit's sludge, and the land that is available.

- Application Methods

Land application methods are determined by the consistency of the sludge. For the anticipated situation in Detroit, the following sludge application methods are feasible:

- Liquid sludge
  application by spray, via pipeline or truck tanks,
  application by subsurface injection;
- Dewatered sludge
  application by spreading and plowing; and
- Composted sludge
  application by surface spreading.

- Land Requirements

Using constraints previously described in Section 5.4, the amount of land necessary for disposal of liquid, dewatered, and composted sludge was calculated. Table 5.5-E shows the minimum amounts of land necessary for land application of sludge, taking into account the nitrogen balance and heavy metals limitations. An additional 25 percent will be needed for buffer zones, roadways and working areas.

The primary difference among the alternatives is in the initial land requirements. Sod farming, for example, only needs 6060 acres (2450 ha) for the initial year of compost application, compared to 60800 acres (24,600 ha) for liquid sludge applied to forests. However, in the longer term, heavy metals limitations determine total land requirements. The harvesting of sod constitutes a heavy metal withdrawal from the soil, and correspondingly its life as a disposal site.

- Land Availability

In order to preserve the environmental quality of the disposal site and provide an effective utilization of the sludge, soil characteristics that are the most advantageous for sludge disposal were identified. These are:

- Moderate permeability;
- Cation exchange capacity greater than 15 meq/100 g soil;
- Greater than 3 feet (1 m) of soil to groundwater;
- Greater than 1.5 feet (0.5 m) of soil to bedrock;

## TABLE 5.5-E

## Minimum Amount of Land Necessary for Land Application of All DWSD Sludge to Year 2000

| Type of Sludge | Crop | Land Requirement (Excluding Buffer) acres (ha) |
|---|---|---|
| Liquid, digested | Forest | 116,000 (46,900) |
| Liquid, digested | Corn & Cover | 95,000 (38,300) |
| Liquid, digested | Sod | 79,000 (31,900) |
| Dewatered, digested | Corn & Cover | 93,000 (37,600) |
| Dewatered, digested | Sod | 74,000 (30,000) |
| Composted | Forest | 96,000 (39,100) |
| Composted | Corn & Cover | 88,000 (35,500) |
| Composted | Sod | 86,000 (34,800) |

- Slope less than 6 percent; and
- 600 feet (180 m) distance from surface waters.

Using these characteristics, the soils that are suitable for land application have been identified within a twelve county area around Detroit. These areas are discussed in the segmented facilities plan (Giffels/Black and Veatch, 1977, Book II).

If the assumption is made that suitable land may be available outside of the twelve county area, or that sites that are slightly less suitable are used, the different types of sludge may have different environmental impacts. The impacts of the following sludge application systems will be discussed:

- Liquid application
  forests, croplands (e.g. corn), non-cropland (e.g. sod);
- Dewatered sludge
  croplands, non-croplands; and
- Compost
  wooded areas (orchards, tree farms), croplands, non-croplands.

- Conclusion

Recycling of nutrients by land application of liquid, dewatered, or composted sludge can be a significant environmental benefit that could become increasingly important in future years. Although land requirements have been computed based on total sludge production, this would not preclude land application as part of a hybrid disposal alternative (Incineration Alternative 9), whereby only part of the sludge would be applied to land. It is, therefore, considered desirable to include a land application alternative for the evaluation analysis.

A truly optimal land application program for all of Detroit's sludge would probably use a combination of several alternatives to take advantage of different land characteristics and cropping practices. Such optimization would be a subject for further study. For the evaluation analysis, however, it was desirable to select a specific alternative to allow more precise cost estimates to be made.

The land application method which was considered most feasible was to apply compost to corn and cover crops, and sod farms. The reasons for this choice were:

- The relatively low capital investment in sludge processing required for composting, compared to the high investment that would be needed for aerobic digestion, if liquid or dewatered digested sludge were chosen;
- The high flexibility of composting to change site capacity, since construction is minimal and little specialized equipment is needed;
- The high quality of compost will help in public acceptance and marketability; and
- Minimal storage requirements for compost.

Forest application was eliminated because of:

- Large initial land requirements compared to cropland;
- Uncertainties regarding effects on wildlife; and
- Long transport distances.

Application of ash to land was eliminated because it would entail risks of heavy metals contimination without providing the benefits of nutrient recovery.

#### 5.5.2.2 Retail Sales and/or Municipal Uses

Two kinds of sludges were considered suitable for retail sales, dried sludge and composted sludge. Subsequently, sludge drying was eliminated as a processing alternative because of excessively high energy demands. Composting remains a feasible processing alternative and retail sales and/or municipal uses of composted sludge will be evaluated in this section.

Municipal usage of the compost, primarily by the Park Department, could provide a readily available market for sales. By selling the compost to this agency or others, disposal costs and problems could be reduced while filling the soil additive needs of municipal agencies. However, due to the large quantities of compost being produced, municipal usage does not provide a reliable enough method of disposal.

A retail sales program would sell composted sludge to the small suburban consumer in garden supply retail stores (bulk users would be handled under a land application program). Compost serves both as a source of nutrients and as a soil conditioner, and composted sludge would compete directly with similar commercial products.

Actual application of composted sludge would be by the individual consumer. It is not necessary to plow compost into the soil; therefore, it is suitable for ornamental vegetation and lawns. A consumer information program would be needed to instruct users on maximum application rates, etc.

Existing regulations on land application of sludge do not specifically address retail sales. Once sludge is sold, the municipal agency has little control over its application. There appears to be no mandatory controls that would prevent excessive or improper sludge applications by private individuals on private land, as long as any crops grown are not sold.

Land requirements for retail sales are essentially the same as for other land application alternatives. Depending upon how compost is used, a minimum of 6100 to 21,000 acres (2500 to 8500 ha) would be required for application of all of DWSD's sludge in 1980 with a total of 77,000 to 112,000 acres (31,000 to 45,000 ha) needed through 2000. These acres would be greatly reduced if retail sales of compost were combined with another disposal alternative so that only part of the sludge would be sold.

A retail sales program would be oriented to the suburban lawn and garden market. This would make use of land not otherwise available to a municipal sludge spreading program. Physical requirements of the land are the same as for other land spreading alternatives.

The total amount of vegetated land in single-family residential areas in urbanized portions of the study area is approximately 220,000 acres (89,000 ha). Thus, it appears that a significant potential market exists for retail sales of composted sludge.

The environmental impacts of retail sales of composted sludge are:

- Useful recycling of nutrients; and
- Possible heavy metals due to individual misuse. This can be minimized by a consumer information program.

In conclusion, it appears that a retail sales program for composted sludge, while feasible, needs further development work in two specific areas:

- Market analysis; and
- Consumer information.

Therefore, retail sales will not specifically be analyzed further, but will be considered a possible sub-alternative of a land application program.

### 5.5.2.3 Sanitary Landfill

Sanitary landfilling was evaluated as a disposal method for dewatered, dried, and composted sludges, ash and char.

Sanitary landfill design for sludge disposal is similar to sanitary landfill design for other refuse. It was assumed landfills would be constructed as follows (U.S.EPA, 1974):

- Impervious liner;
- Limited public access;
- Waste layers not exceeding 2 feet thick;
- Compaction of each layer, and covered by a minimum of 6 inches of soil at the end of each working day;
- When landfill is completed, coverage with a minimum of 2 feet of soil;
- Suitable plant cover established to prevent erosion;
- Monitoring of groundwater and surface waters for heavy metals, persistent organics, pathogens, and nitrates; and
- Collection and treatment of leachate.

All sites would require monitoring and control of runoff. Groundwater tables would, where necessary, have to be lowered by drain fields. The MDNR regulates the design, site preparation and operation of sanitary landfills (State of Michigan, 1965). The U.S. EPA's draft guidelines for sludge management also address sanitary landfills.

There are few natural limitations to the placement of sanitary landfills. However, such features as low to moderate slopes, adequate depth to groundwater, lack of flood hazards, and availability of suitable cover soils are desirable.

Table 5.5-F presents the estimated land required to dispose of each type of sludge to the year 2000.

It is assumed that the same areas could be used for each type of sludge and that the same operational procedures could be used. Vegetational loss, wildlife disruption, soil loss, and population relocation are related to the land area that must be cleared. Impacts on surface water quality relate to soil loss and the quality of the sludge. Raw sludge, both liquid and dewatered, would have the greatest impacts, as it has the greatest potential for pathogens. The nitrate levels of stabilized sludge and the potential for particulates

Table 5.5-F

Estimated Land Requirements for
Landfilling of Sludge to the Year 2000

| Sludge Characteristics | Land Required in 1980, Acres* | Total Land Required by Year 2000, Acres* |
|---|---|---|
| Dewatered, Raw** | 51 | 1160 |
| Dewatered, Digested** | 37 | 798 |
| Dewatered, Lime Stabilized** | 64 | 1450 |
| Dried | 34 | 750 |
| Ash | 13 | 320 |
| Char | 13 | 320 |
| Compost | 150 | 3400 |

* 1 acre = 0.405 ha

** Dewatered sludge assumed 40 percent solids of dried sludge, ash and char to be carried by runoff water results in a moderate level of impacts. Compost has reduced pathogen levels and lower nitrogen and heavy metals concentrations per unit of surface area when compared to the other sludge conditions and would result in less potential hazard to surface waters than dewatered sludge.

Groundwater should not be impacted if an impermeable liner is used for the landfill. Nitrate is of the most concern for leaching, as it readily contaminates groundwater and causes health problems. Heavy metals from landfilled sludges have not been found to be a problem for groundwater.

Sludge that has not been stabilized will have an offensive odor, resulting in a significant adverse impact. Stabilized and dried sludge, with only a minor odor during dry atmospheric conditions, will have a stronger odor after a rain. Ash and char have had all or most of the organic matter removed, resulting in a negligible odor problem. The composting process also results in a relatively odor-free product. The impact on aesthetics is a combination of visual impacts of the operation and odor impacts.

### 5.5.2.4 Trenching

Trenching is the equivalent of sanitary landfilling for liquid sludges, and was evaluated for both raw and stabilized liquid sludge.

Trenches were assumed to be 2 feet (0.6 m) wide and 5 feet (1.5 m) deep, filled with 2 feet (0.6 m) of liquid sludge, and spaced at 6 feet (1.8 m) intervals; the lengths of trenches would fit the site requirements. All trenches would be recovered with the original soil material. Site limitations for trenching are basically the same as for sanitary landfilling.

Using the above design assumptions, the land required for trenching all of the sludge produced to the year 2000 is 130,000 to 230,000 acres (54,000 to 93,000 ha), depending upon whether sludge is stabilized.

Environmental impacts associated with trenching of raw and stabilized sludge are similar to those listed under sanitary landfill. Vegetational destruction, soil loss and operational nuisances such as dust, noise, and odors will occur. Groundwater may be affected as impermeable liners are not normally used for trenching operations. Nitrates in the sludge would be able to leach into the water table. The higher pathogen level of raw sludge would not be a major problem, as bacterial and viral transmittal through the soil is minor. However, *Ascaris* (roundworm) eggs can survive in the soil for several years after introduction. This would require monitoring of their concentration in the sludge and the controlled use of the disposal site to reduce the potential health hazard.

As moisture leaves the sludge, some settling of the soil cover will occur. This may require some recontouring of the site.

### 5.5.2.5 Sludge Disposal in Remote Drying Beds

The facilities planning consultant (Giffels/Black and Veatch, 1977, Book XII) has proposed an alternative whereby liquid sludge would be transported by pipeline to sludge drying beds located in Lake County, Michigan. Officials there have been receptive to the idea as a means of increasing employment in the area. U.S. EPA has awarded Lake County officials a $100,000 grant to study the feasibility of implementing this or other land disposal schemes in the County.

Raw sludge would be pumped by a 250 mile (400 km) pipeline from Detroit to Lake County, where it would be stored in anaerobic lagoons for at least six months to stabilize. The sludge would then be placed in drying beds where most of the water content would drain through sandy soils into the groundwater.

The design of the drying beds is regulated by MDNR which follow the "Ten States Standards" for design guidance. Some variance from these guidelines may be necessary because of the nature of this alternative.

The facilities planning consultant has estimated that the drying beds will require a total area of 2560 acres (1036 ha) to hold sludge to the year 2000.

In order to determine the impact potential of this alternative, four sections of land in Lake County, Michigan identified by the facilities planning consultant (Giffels/Black and Veatch, 1977, Book IX) were studied. These sections located in Pere Marquette State Forest are representative of the biota in the region, but are not necessarily the sections that would be used should this alternative be implemented.

During construction and preparation of the site, the vegetation would be completely removed, stream re-routed wildlife displaced, and the soil surface eroded. In the sections of Webber Township in Lake County that are being used as an example, a well-established oak-pine forest is present. The soil is sandy and plant growth indicated excessively drained conditions. Trees are second growth and do not appear healthy. Dense underbrush occurs in some areas while others have been cleared and are being reforested. Jack (*Pinus banksiana*), red (*P. resinosa*) and Eastern white (*P. strobus*) pines are the dominant confiers, while white (*Quercus alba*), and bur (*Q. ellipsoidalis*) oaks are the major deciduous species. This forest type is the habitat of Kirtland's Warbler, an endangered species. Found in Lake County in the past, a survey is being made by MDNR to determine if they are still present (F. Ignatoski, Personal Communication, 1977). Fauna observed during field investigations included a vulture, an unidentified species of hawk, a whitetailed deer and various songbirds. Removal of the vegetation would force the wildlife to migrate to adjacent natural areas. Although a large section of land is involved, it is not a unique habitat. A significant portion of the county has this type of vegetation, much of it in state or federal parks. Should subsequent study discover any rare or endangered flora or fauna in the area, modifications to this alternative will be necessary.

Re-routing of streams would have a major impact. The streams are small, but re-routing would result in the loss of aquatic biota downstream of the construction area from sedimentation and loss of water. Depending on the number of streams and their location, re-routing may result in diversions of water from one stream to another. This could have a significant impact for the downstream areas, especially during periods of low flow.

Groundwater impacts will occur from drainage of the sand beds. The nitrates contained in the sewage would readily be carried with the liquid fraction to the groundwater layers. The sandy soils found in Lake County would not renovate the effluent effectively for nitrate removal. Nitrate levels in the groundwater presently range from 0 to 3 ppm (Lake County, Health Department, Personal Communication, 1977). Adding any nitrates would degrade the existing quality. Runoff from the lagoon site would be controlled, resulting in negligible impacts to surface waters from this source.

Relocation of families in the study area would result in a moderate impact. Many homes are house trailers that could be transported with relative ease. The population density is low, further reducing the impacts.

### 5.5.2.6 Industrial Reuse

The following section discusses the use of sludge by industries as a fuel or a construction material. The sludges considered for industrial reuse were:

- Fuel
  dewatered sludge,
  dried sludge,
  char, and
  compost; and
- Construction material
  ash.

Sludge could be used as a fuel to produce steam or electric power or could be used in an industrial fuel application, such as coking. Use of sludge for coking could be particularly advantageous because the Allied Chemical Corporation operates large coke ovens near the DWWTP. The primary disadvantages of sludge as an industrial fuel are its low net heat value because of its water content (dried sludge has a high heat value, but requires energy for drying), its high ash content, heavy metals content, and the variability of sludge properties. These disadvantages are sufficient to eliminate from study the use of sludge in coking ovens.

The inconsistent properties of sludge ash are a serious disadvantage for use as a construction material. Industrial users would require contractual commitments with respect to both quality and quantity, and such commitments could only be met in a limited manner by DWSD.

The environmental impacts associated with the use of raw, stabilized dewatered or dried sludge, char or compost as a fuel source would be similar to those described under incineration and sanitary landfill. Burning would produce an ash which would require disposal. Land requirements for disposal of this ash would be the same as those for sanitary landfill.

### 5.5.2.7 Land Reclamation

The purpose of using sludge to reclaim strip mines or other denuded areas is to utilize the organic matter and nutrients of the sludge to establish a suitable topsoil which will permit natural vegetation to become re-established. The vegetation, in turn, slows erosion, increases evapotranspiration, and reduces acid mine drainage.

The amount of land that could be reclaimed by using DWSD's sludge can be estimated by assuming 3000 lb./ac (3400 kg/ha) of nitrogen is required to restore strip mine spoils to full productivity. This would be applied in a one-time application of sludge, accompanied by regrading as necessary and plowing the sludge into the spoils. Using composted sludge, approximately 69,000 acres (28,000 ha) of land could be restored.

The application of sludge to strip mines has adverse and beneficial environmental impacts. The addition of organic matter to the soil would have a beneficial impact, as it would encourage plant growth which would act to reduce erosion at the site. As these areas are not used for agricultural purposes, higher loadings of sludge are possible. The heavy metals would not be a concern for plant uptake. To prevent problems from runoff to surface waters, a collection and drainage system would be desirable.

The amount of land available for reclamation within the study area totals only 9400 acres (3800 ha). It is not feasible to cross state boundaries with large quantities of sludge because of implementation difficulties. Therefore, using sludge for reclaiming strip mines will be considered only as a limited sub-alternative of land application.

The facilities planning consultant (Giffels/Black and Veatch, 1977, Book IX) also proposed using incinerator ash to create artificial islands in Lake Erie or Lake St. Clair. These islands would be used for recreational purposes. Assuming a typical near-shore lake depth of 10 feet (3.0 m), allowing 10 feet (3.0 m) for lake bottom soils consolidation and an island height of 15 feet (4.6 m), about 90 acres (36 ha) of islands could be created by the year 2000.

Building islands of incinerator ash in lakes may have a significant impact on aquatic biota. The amount of ash to be disposed of would result in a significant loss of lake area, as well as natural shoreline. The native biota would be lost, although some may be replaced by growth along the sides of the cofferdams. The greatest potential for impact would result from a storm rupturing the dam, spilling the heavy metal concentrated in the ash into the lake. This would have a significant adverse impact on lake biota.

The disposal of sewage sludge in oceans by similar means as proposed here have been prohibited by U.S. EPA. Many of the reasons for that action are also applicable here.

The water quality standards of the International Joint Commission, navigable water requirements and storms all combine to make this alternative not feasible.

### 5.5.2.7 Co-Disposal

Detroit Edison Power Company disposes of approximately 1,600,000 tons per year (1.5 x $10^9$ kg/yr) of residuals, principally ash and fly ash, at four landfill sites. They are already searching for additional disposal sites because more coal will be used in the future in lieu of gas or oil. Sludge ash would add another 500 average tons per day (454,000 kg/day) to disposal quantities (see table 5.5-C) and would add additional quantities of heavy metals. For these reasons, Detroit Edison was not interested in disposing of the DWSD's ash.

Dewatered and stabilized sludge, dried sludge, compost, ash or char could be landfilled along with municipal refuse.

Solid wastes generated in the study area total about 9000 tons per day (8.1 x $10^6$ kg/day). The addition of the sludge generated at the wastewater treatment plant would increase the landfill requirements 10 to 40% depending on the nature of the sludge (Giffels/Black and Veatch, 1977, Book XII). Existing landfills within the study area have a remaining useful life of only three to five years, which could be reduced to as little as two years if sludge is added. Procedures for landfilling a mixture of sludge and refuse would differ from refuse landfilling only in that an impermeable liner is not necessarily required for refuse alone. Disposal of dewatered or dried sludge or compost with municipal refuse may result in odor and leaching problems not normally associated with refuse landfills. Economy of scale, and improved handling properties of the refuse/sludge mixture could result in lower costs. Implementation of a co-disposal alternative would require formation of a regional solid waste disposal agency. Although co-disposal of sludge and municipal refuse does not appear feasible at this time because of the shortage of sanitary landfills, sludge could utimately be considered in planning solid waste disposal for the region.

Disposal of sludge incinerator ash or pyrolysis char with industrial fly ash would result in one sanitary landfill instead of two. However, the required amount of land in any one place would be larger than the constituents of the incinerator ash may differ enough from fly ash to require different control systems.

### 5.5.2.8 Co-Incineration with Municipal Refuse

Three of the four municipal refuse incinerators in the City of Detroit have been shut down since 1970 as the result of stricter air pollution laws. The fourth is utilized only for processing pathological wastes (Giffels/ Black and Veatch, 1977, Book IX). Thus, any co-incineration alternative would require construction of entirely new incineration facilities or costly improvements of the existing ones for the combined sludge and refuse. This would constitute a new source of particulates in an area already designated as an air quality maintenance area. Co-incineration is, therefore, rejected on the basis of air pollution impacts.

Besides impacts associated with air pollution, other environmental impacts to be considered are the landfill requirements needed for the ash produced by the incineration process. The characteristics of the product may be sufficiently different from municipal refuse to require a different design system. The impacts to be expected in landfill were previously discussed.

### 5.5.2.9 Export from the Region

The alternative of exporting sludge from the Great Lakes region presumes that the importer would have a beneficial use for the sludge, such as land application or industrial reuse. Chicago currently exports sludge to Florida and Texas for use in orange groves, but this is not feasible for Detroit's situation because of the high heavy metal content of the sludge. The facilities planning consultant was not able to identify any other importers of sludge, and this alternative was eliminated from further consideration.

### 5.5.2.10 Contract Hauling

The present system of contract hauling of ash places responsibility for disposal on entities other than the DWSD. There are not assurances that the hauler will dispose of the ash in an environmentally sound manner. Contract hauling would, therefore, be acceptable only as an institutional alternative for implementing a disposal method discussed previousely.

The environmental impacts of these alternatives would depend upon the disposal method. Impacts for the various methods available have been discussed in Section 5.5.

## 5.6 Evaluation of Residuals Management Alternatives

### 5.6.1 Sludge Processing and Disposal

Sections 5.4 and 5.5 consisted of all the possible sludge processing and disposal alternatives that were presented and initially screened to determine their feasibility. In many cases, this initial screening eliminated all but one of the alternatives, or based on engineering judgment, one was chosen. This section will serve as a final evaluation for those portions of the sludge systems which are considered feasible.

A total of five major alternatives with three sub-alternatives remain feasible systems for sludge processing and disposal:

- Land applications of composted sludge:
- Sanitary landfilling of composted sludge:
- Digestion of liquid sludge in remote anaerobic lagoons and disposal on sludge drying beds;
- Pyrolysis with disposal of char in a sanitary landfill;
- Incineration Alternative #5 Mandated Construction;
- Incineration Alternative #7 Combustion Modification to All Three Complexes; and
- Incineration Alternative #9 Combustion Modifications to Complexes I and II; No Construction of Complex III and Composting with Land Application for Excess Sludge.

Each of these alternative systems have different costs, energy, and environmental impacts which will be evaluated in detail in this section. A detailed description of each of these systems is presented as follows.

#### 5.6.1.1 Land Application of Composted Sludge

Under this alternative, sludge incineration would be abandoned and all sludge would be composted and applied to agricultural lands. For preliminary analysis, it was assumed that half of the compost would be used for growing corn and cover crops, and half would be used for sod farms. Using the maximum allowable compost application rates based on nitrogen and heavy metals limitations and assuming that no industrial pretreatment will occur during the planning period, it is estimated that a minimum of 14,000 ac (5700 ha) would be needed for land application in 1980 and that 83,000 ac (34,000 ha) would ultimately be needed by the year 2000. Acreage receiving compost would average 21,000 ac (8500 ha) each year. By comparison, 215,000 ac (87,000 ha) in the study area are used for agriculture.

For cost and energy analysis, it was postulated that two composting sites would be needed to serve areas west and north of the study area; one in Brandon Township, 45 miles from the DWWTP, and another in Canton Township, 25 miles from the DWWTP. It must be emphasized that these are only preliminary locations selected so that reasonable estimates can be made of costs and energy impacts of this alternative. By the year 2000, each site would be 200 acres (81 ha) in size and would process 532 tons/day (483,000 kg/day) of dewatered sludge into 766 tons/day (699,000 kg/day) of compost. Site design would use the aerated pile process developed at Beltsville, Maryland (Colacicco and Christensen, 1976). This process uses perforated plastic pipes connected to blowers to draw air through piles of sludge and wood chips (the wood chips are used to add bulk). The composted sludge is reported to be stabilized and essentially pathogen-free after 21 days in the pile (Epstein et al., 1976). The compost is then spread out to dry, and stored for 30 days to remove any remaining offensive odors. Finally, the compost is screened to recycle part of the wood chips. Each site would include stormwater runoff controls to retain stormwater for gradual discharge to sewers.

Hauling costs would be extremely high because the DWWTP is located far from the agricultural areas. Capital costs of composting comprise only 15 percent of total costs. Unit costs of this alternative are $83 per ton of sludge, as shown in Table 5.6-A. Municipal usage and consumer sales and pickup could partially defray these costs.

### 5.6.1.2 Sanitary Landfilling of Composted Sludge

This alternative would use the composting process to stabilize raw dewatered sludge before placing it in a sanitary landfill. Because of the large areas required for the composting and landfill operations, it was assumed that both the composting site and the sanitary landfill would be located in Brandon and Oxford Townships, approximately 45 miles from the DWWTP. Again, it must be emphasized that this is only a preliminary selection to allow cost and energy comparison of sludge disposal alternatives.

Dewatered sludge would be hauled to a single large composting site 400 (162 ha) acres in size. Design of this site would be similar to those two sites described for land application of compost, but it would be as large as both sites combined.

## TABLE 5.6-A

### Estimated Unit Costs and Energy Consumption of Sludge Processing and Disposal Alternatives

| Alternative (1) | Cost Per Dry Ton of Sludge (2) | Energy Consumption Per Dry Ton of Sludge (BTU/Ton) |
|---|---|---|
| Land application of composted sludge | $83 | 1,300,000 |
| Sanitary landfilling of composted sludge | 80 | 1,900,000 |
| Digestion of liquid sludge in remote anaerobic lagoons and disposal on sludge drying beds | 54.72 | 7,000,000 |
| Pyrolysis with disposal of char in a sanitary landfill | 64 | 1,100,000 |
| Incineration Alternative #5: (Mandated construction) PC-400 on Complex I, tall stacks, and Complex III as designed, with disposal of ash in a sanitary landfill | 99 | 8,700,000 |
| Incineration Alternative #7: Combustion air modifications to all incinerators, PC-400 type scrubbers on Complexes I & II, scrubbers as designed on Complex III, disposal of ash in a sanitary landfill | 63 | 1,100,000 |
| Incineration Alternative #9: Combustion air modifications and PC-400 type scrubbers on Complexes I and II for 1051 tpd of sludge; land application of 13 tpd composted sludge; no construction of Complex III | 51 | 1,100,000 |

(1) All alternatives, except for liquid sludge disposal, include vacuum filters.

(2) Based on 1064 tpd, dry weight of sludge.

Assuming a compacted density of 40 lb./cu. ft. (640 kg/m3) for compost, approximately 8300 cu. yd/day (6300 m3/dl) of landfill volume will be required by the year 2000. Design of this landfill would include an impermeable liner, compost stacked in five layers of 2 feet (0.6 m) each, separated by 6 inches (0.15 m) of covered material, and a final layer of 1.5 feet (0.5 m) of compacted cover material. With this configuration, the landfill will cover 3400 acres (1400 ha) by the year 2000.

Costs of sanitary landfilling of composted sludge are shown in Table 5.6-A. The unit cost of this alternative is $80 per dry ton.

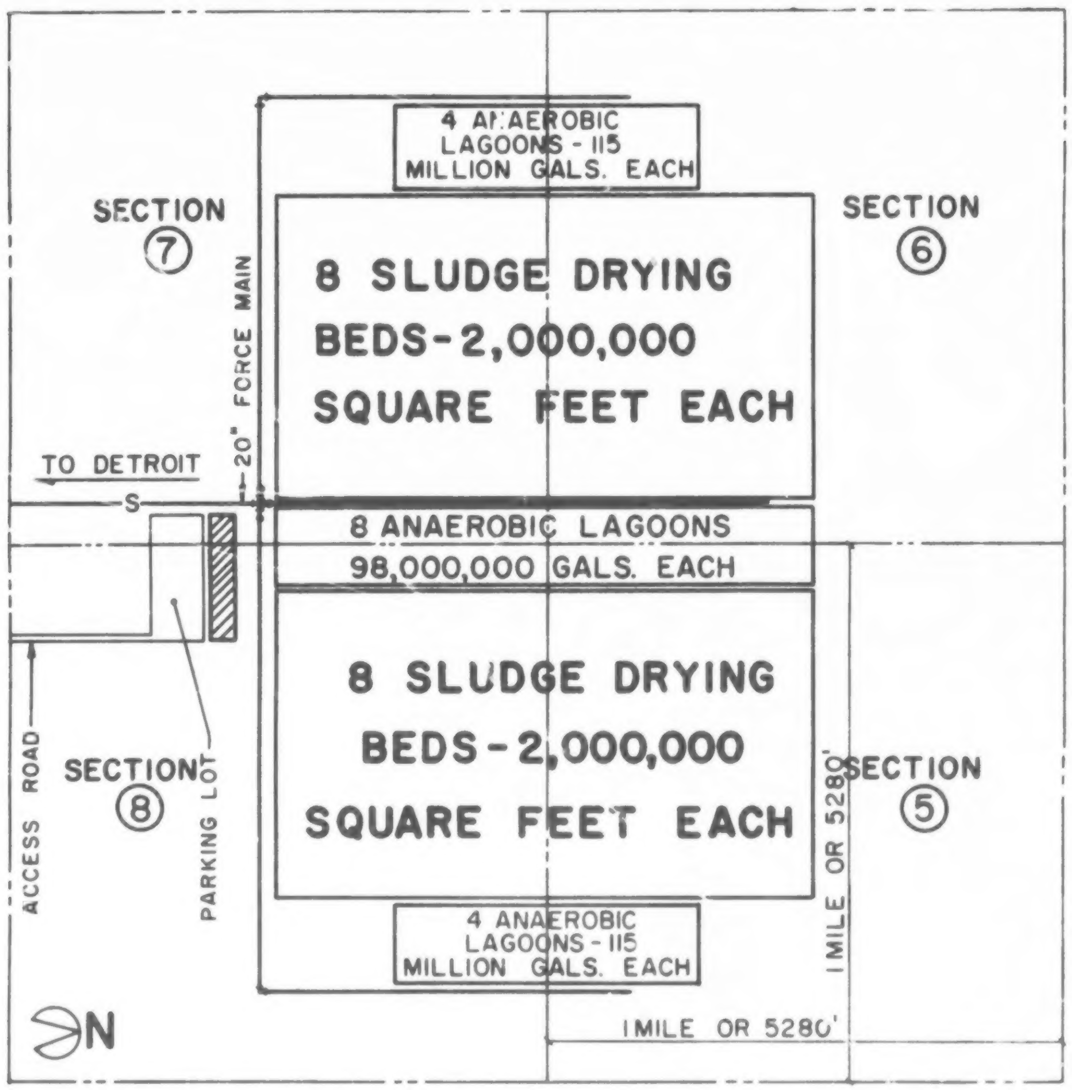
### 5.6.1.3 Digestion of Liquid Sludge in Remote Anaerobic Lagoons and Disposal on Sludge Drying Beds

This alternative would use a pipeline to transport sludge from the DWWTP to Lake County, Michigan for further processing and disposal. Lake County was chosen because of their interest previously shown in land disposal schemes, and their desire to generate employment opportunities.

The pipeline would be 20 inches (0.5 m) in diameter and 250 miles (400 km) long, with a flow time of approximately four days from Detroit to Lake County. About 50 in-line sludge pumping stations would be required.

The site tentatively selected for evaluation purposes in Lake County is comprised of Sections 5, 6, 7, and 8 of Township 18 North, Range 13 West, located in the northwest corner of Webber Township. This land is part of the Pere Marquette State Forest. At the end of the pipeline, the raw liquid sludge would be distributed to one of 16 lined anaerobic lagoons about 30 feet (9 m) deep, and stored for at least six months. After this retention period, the sludge will overflow to sludge drying beds. The site plan is shown in Figure 5.6-A.

In the drying beds, water in the sludge will be lost through evaporation, or seepage to groundwater. Evaporation losses will then be approximately equal to pan evaporation rates less rainfall, and would account for a net average loss of 0.1 mgd (400 $m^3$/day) or 2 percent of the sludge water content. The remainder of the water can be expected to eventually seep into the groundwater. Assuming an inorganic nitrogen fraction of 0.5 percent dry weight in the sludge, and neglecting any mineralization of organic nitrogen, the inorganic nitrogen content of the leachate could approach 200 mg/l. Without extensive analysis, it is not possible to determine the exact impacts of this leachate. It can be concluded, however, that this alternative has (at least)


4 ANAEROBIC LAGOONS - 115 MILLION GALS. EACH
SECTION ⑦
SECTION ⑥
20" FORCE MAIN
8 SLUDGE DRYING BEDS-2,000,000 SQUARE FEET EACH
TO DETROIT
S
8 ANAEROBIC LAGOONS 98,000,000 GALS. EACH
8 SLUDGE DRYING BEDS-2,000,000 SQUARE FEET EACH
ACCESS ROAD
SECTION ⑧
PARKING LOT
SECTION ⑤
1 MILE OR 5280'
4 ANAEROBIC LAGOONS - 115 MILLION GALS. EACH
N
1 MILE OR 5280'

PROPOSED LAKE COUNTY DISPOSAL AREA SITE LAYOUT

Figure 5.6-A

LEGEND

| | |
|---|---|
| ▨ | ADMINISTRATION/LABORATORY BLDG. |
| —S— | SLUDGE PIPELINE |
| —•— | GATE VALVE |
| + L | TEE OR ELBOW |
| —·—·— | SECTION LINE |
| ⑤ | SECTION NUMBER |
| ⊗ | LAGOON DISCHARGE STRUCTURE |

the potential to create severe groundwater pollution from ammonia and/or nitrate nitrogen.

The facilities planning consultant (Giffels/Black and Veatch, 1977, Book XII) assumed that a 1000 foot (305 m) buffer zone would be needed to control odors. This impact can be estimated more quantitatively by assuming 3 mg/l sulfide in the sludge, a pH of 6.0, and relatively calm wind conditions (i.e., stability class F at 1 m/s wind speed). Under these circumstances, concentrations of hydrogen sulfide at the site boundary could approach 4000 ug/m$^3$. The odor threshold of hydrogen sulfide is about 0.6 ug/m$^3$. Even if far less conservative assumptions are made (i.e., sludge pH = 8.3, stability class A, 2m/s wind speed), the concentration of hydrogen sulfide at the site boundary will still exceed the threshold odor concentration by at least a factor of ten. Thus, it is concluded that the lagoons, as designed, will result in a detectable odor beyond the site boundaries.

Unit costs of this alternative as presented in Table 5.6-A are $55 per ton.

It is possible that groundwater pollution could be avoided by constructing an underdrain system and collecting the leachate. Approximately 6 mgd of leachate would be collected for treatment by land application. A preliminary estimate of costs indicates leachate collection and treatment could increase annual costs by approximately $3,500,000/yr. or about $9 per ton of sludge.

Many technical matters concerning this alternative have not been resolved. These include:

- Reliability of transport system;
- Quantity and quality of leachate;
- Movement of groundwater at the site;
- Need for leachate collection and treatment, and if necessary, type of treatment and cost of treatment and collection;
- Dewatering characteristics of the sludge; and
- Effectiveness of the anaerobic lagoons in stabilizing sludge.

All of the above would have to be resolved through further studies.

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### 5.6.1.4 Pyrolysis with Disposal of Char in a Sanitary Landfill

The Redker-Young pyrolysis process involves heating and compressing sludge in a retort generating volatile oils, methane and char. This process has been tested and successfully pyrolyized raw sludge from the DWWTP in a demonstration unit at Okemos, Michigan (Giffels/Black and Veatch, 1978, Book XII). Figure 5.6-B shows the process diagram.

In order to establish the suitability of the pyrolysis process for the Detroit situation, the facilities planning consultant (Giffels/Black and Veatch, 1977, Book XII) recommended that, if this alternative is adopted, that a 100 ton per day pilot plant, costing $3 to $3.5 million, first be constructed. This would also serve as a production unit, should the process prove successful.

Assuming that a 100 ton per day pilot/production unit is successful, full scale units of 250 tons per day capacity would then be constructed through conversion of existing incinerators or complete reconstruction. Applying the same reliability criteria to the pyrolysis units as were applied to incinerators, six (6) 250 ton per day units will have to be added to process 1064 tons of sludge per day.

Because the pyrolysis process loses relatively little heat to excess air (a major heat loss for incineration), it is expected to operate nearly autogenously for Detroit's sludge. However, cost estimates assume that powdered coal will be used both to condition the sludge and provide energy for pyrolysis. It is also assumed that char would have little commercial value and would be hauled to a sanitary landfill, the same as incinerator ash.

Unit costs at the pyrolysis alternative, including the pilot unit and the landfill are $64 per ton.

### 5.6.1.5 Incineration

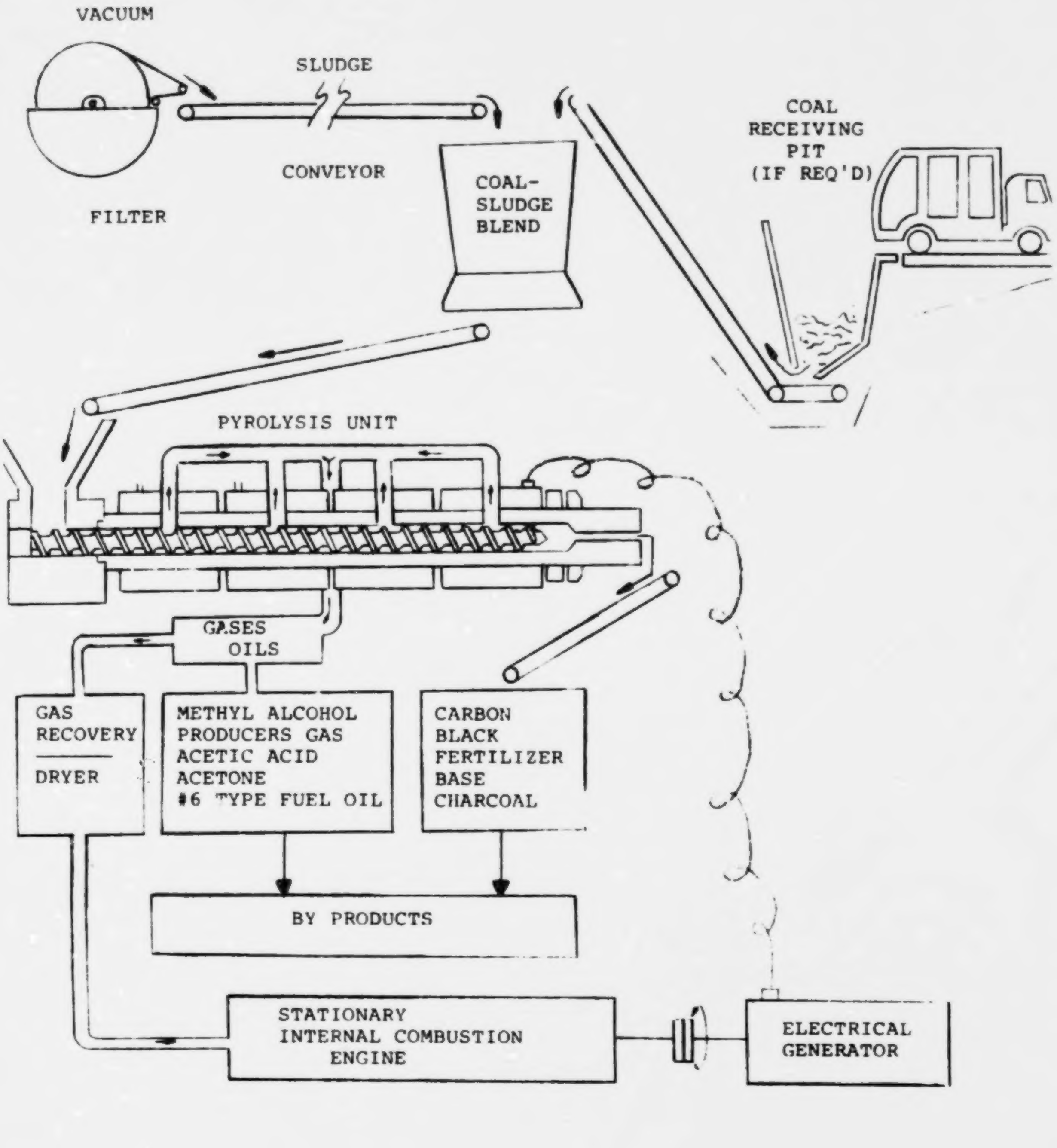
- Incineration Alternative #5

This alternative includes construction mandated by the plant's NPDES permit:

- PC400 modification to Complex I;
- Construct tall stacks; and
- Construct Complex III as designed.

Figure 5.6-B

REDKER-YOUNG PROCESS FLOW DIAGRAM


VACUUM
FILTER
SLUDGE
CONVEYOR
COAL-
SLUDGE
BLEND
COAL
RECEIVING
PIT
(IF REQ'D)
PYROLYSIS UNIT
GASES
OILS
GAS
RECOVERY
DRYER
METHYL ALCOHOL
PRODUCERS GAS
ACETIC ACID
ACETONE
#6 TYPE FUEL OIL
CARBON
BLACK
FERTILIZER
BASE
CHARCOAL
BY PRODUCTS
STATIONARY
INTERNAL COMBUSTION
ENGINE
ELECTRICAL
GENERATOR

Assuming unit reliability criteria defined in the evaluation phase, this alternative will be able to process 1714 dry tons per day (1,555,000 kg/d) of sludge, well above the required capacity of 1064 tpd (965,000 kg/d) for the year 2000.

The extra incineration capacity of this alternative could provide a reserve for incineration of solids eventually to be removed from combined sewer overflows.

The combined capacities of Complexes I and II alone, (see Table 5.5-B), under this alternative, are capable of treating the sludge from 959 mgd (3,630,000 $m^3$/d). Therefore, even with additions of CSO storage, Complex III does not appear to be needed for quite a few years.

Studies in connection with the segmented facilities plan identified deficiencies in control equipment, sludge feeding, and emissions control; many of these will be corrected by PC 400. No basic structural deficiencies were identified which would compel replacement of Complex I incinerators in the near future.

This alternative will continue to violate the 24 hour peak standard for particulates, but it will be an improvement over existing conditions.

As this alternative would make relatively few changes to the combustion process, auxiliary fuel will still be required for incinerating sludge, although better operating procedures could reduce fuel consumption. The use of afterburners, however, adds greatly to the energy demands of this alternative. It is estimated that auxiliary fuel requirements will amount to the equivalent of 19,100,000 gallons of #2 fuel oil per year (72,293,500 liters).

To estimate landfilling costs on an equal basis, it was assumed that all ash would be hauled to a landfill in Brandon or Oxford Townships in Oakland County. This is the same site identified for landfill of compost, except that the smaller volume of ash requires only 310 acres of landfill. Design of the sanitary landfill would be the same as for compost, i.e. an impermeable liner, ash stacked in 5 layers of 2 feet (0.6 m) each, separated by 6 inches (0.15 m) of cover material, and a final layer of 1.5 feet (0.46 m) of cover material.

Unit costs of this alternative are $99 per ton.

- Incineration Alternative #7

This alternative includes the following items:

- Combustion air modification to all those complexes (Giffels/Black and Veatch, 1977, Book IX);
- Addition of PC-400 type scrubbers to Complex II;
- PC-400 modifications to Complex I, excluding afterburners; and
- Construction of Complex III incinerators with scrubbers as designed.

The capacity of this alternative is 1745 tpd (1,583,000 kg/d). The discussion of Incineration Alternative #5 concerning excess capacity also applies to this alternative. Elimination of the afterburners on Complex I, however, raises the combined capacities of Complexes I and II to the equivalent of 988 mgd (3,740,000 $m^3$/d) of sewage flow.

Implementation of this alternative would require a pilot study, to test the proposed combustion modification on one incinerator, before converting the others.

This alternative is expected to comply with air quality standards for particulates for the effects of the incinerators themselves. However, other industrial sources may still cause air quality standards to be violated.

Sanitary landfilling of ash will be exactly the same as described in Incineration Alternative #5.

The elimination of afterburners and the ability of the incinerators to incinerate sludge autogenously greatly reduce fuel requirements for this alternative. Estimated unit costs are $63/ton.

- Incineration Alternative #9

Evaluation of the previous two incineration alternatives determined that Complex III incinerators will not be needed until after 1995. This alternative optimizes Complexes I and II and uses land application of compost for any remaining sludge. This includes:

- Combustion air modifications to Complexes I and II (Giffels/Black and Veatch, 1977, Book IX);
- Addition of PC-400 type scrubbers to Complex II;
- PC-400 modifications to Complex I, excluding afterburners; and
- Composting and land application of any excess sludge.

The firm incineration capacity of this alternative is 1051 tpd (953,000 kg/d), which is equivalent to a sewage flow of 959 mgd (3,630,000 $m^3$/d). A 13 tpd (12,000 kg/d) composting site would be located next to the treatment plant, and compost would be hauled to land application sites 45 miles away. The costs of disposal at this site are relatively high, as shown in Appendix 11.3 because it is based on the "worst case" situation. Costs could be reduced by shortening the haul distance, since the quantity of compost for disposal is small and finding in any case, it would not be necessary to implement composting until after 1995.

A particular advantage of this alternative is that it minimizes the need for capital investment and still maintains the flexibility to implement other incineration options. For example, should sludge quantities prove to be greater than anticipated, and composting prove infeasible for any reason, Incineration Alternative #7 could be implemented at little or no penalty cost. A similar variation could be to only build part of Complex III when it is needed.

The incinerators in this alternative will comply with air quality standards for particulates.

Sanitary landfilling of ash would be exactly the same as described for Incineration Alternative #5.

Excellent auxiliary fuel economy and a small capital investment give this alternative the lowest unit cost of $51 per ton.

Archaeological and historical sites would be minimally affected, if at all; however, a survey before completion of any Step II construction Grant is required.

### 5.6.2 Environmental Analysis of Feasible Alternatives

Table 5.6-B presents an environmental analysis matrix of the feasible residuals disposal alternatives. The matrix presents the differential impacts between alternatives. The following discussion presents the impacts common to all alternatives.

Additions to the DWWTP will cause any vegetation present to be destroyed. The limited area impacted and the nature of the sites suggest this impact is really insignificant.

Due to the widely different sludge residuals disposal alternatives, very few environmental impacts are common to all alternatives.

### 5.6.3 Summary of the Analysis of Feasible Alternatives

The major impacts of the alternatives are generally due to three factors:

- Land requirements;
- Cost; and
- Energy requirements.

The land requirements are in direct proportion to the volume of residuals to be disposed. Due to incineration reducing the sludge to ash, the landfill requirements are significantly less than for any of the other types of disposal. The two compost alternatives will require the largest amount of land, 3800 acres for landfill of compost, and 83,400 acres for the land application of compost. The incineration alternatives require 260 acres for landfill of ash by contrast.

The costs of the alternatives per ton of sludge processes range from $51/ton for Alternative #9 (incineration) to $99/ton for Alternative #5 (incineration). The other alternatives cost somewhere between the two extremes, the anaerobic lagoons being slightly more than Alternative #9 (incineration).

The energy usage for each alternative system shows that on a BTU's/ton of dry sludge processes Incineration Alternatives #7 and #9 and pyrolysis have the lowest energy requirements. The Incineration Alternative #5 has the highest energy requirements.

The evaluation shows that Incineration Alternative #9 has the lowest costs, land requirements and energy requirements and provides the greatest amount of flexibility for future needs. Alternatives other than Incineration Alternative #9 have greater costs and impacts in at least one category. Therefore, Incineration Alternative #9 is the most feasible alternative for sludge residuals disposal.

## 5.7 Institutional Alternatives Evaluation

### 5.7.1 Management Alternatives

Alternatives for management of the DWSD regional system are presented and analyzed in the following section. Due to the complexity of the existing system and its management problems, a more satisfactory solution may be developed. However, the implementation of any change may be most difficult. These alternatives have been presented and analyzed by the facilities planning consultant (Giffels/Black and Veatch, 1977, Book XIII). Table 5.7-A presents an evaluation of all the management alternatives on one page for convenience.

## Table 5.6-B

## Environmental Analysis Matrix of Feasible Residuals Disposal Alternatives

| Impact Category | Incineration and Landfill (3 subalternatives) | Pyrolysis and Landfill |
|---|---|---|
| AIR | Alt. #5 - Particulate level lower than present but still in violation of 24 hr. peak standard.<br>Alt. #7 - Particulate air quality standards will be met.<br>Alt. #9 - Compliance with air quality standards for particulate.<br>ALL: Potential odors from poor operation. Potential air quality violations from poor O&M. | Negligible odor at treatment site and landfill. Contribution to particulate air pollution not determined but likely less than incineration. |
| SOILS | | |
| Erosion | Erosion to soil and land area currently being excavated in landfill - exact amount not known. | Erosion to soil and land area currently being excavated in landfill - exact amount not known. |
| Heavy Metal Contamination | Proper landfill design includes impermeable liner to minimize soil contamination. | Proper landfill design includes impermeable liner to avoid soil contamination. |
| Nutrients Added | Minimal nutrient value of ash. Further minimalization of significance due to depth (24 in.). Only trees will have the necessary roots to possibly realize any benefits. | Minimal nutrient value of ash. Further minimalization of significance due to depth (24 in.). Only trees will have the necessary roots to possibly utilize any of the benefits. |
| Organics Added | Not applicable | Not applicable |

Table 5.6-B

(continued)

| Compost and Landfill | Compost and Land Application to Ag. Land | Anaerobic Lagoons and Drying Beds |
|---|---|---|
| Some odor anticipated at composting site, landfill and during transport of sludge. | Some odor anticipated at composting site, landfill and during transport of sludge. | Detectable odor beyond site boundary. Hydrogen sulfide odor threshold exceeded by at least a factor of 10. 1000 ft. buffer zone required. |
| Insignificant odor problems from composting site if properly designed and operated. | Insignificant odor problems from composting site if properly designed and operated. | |
| Insignificant odor problems at landfill site. | Insignificant odor problems at landfill site. | |
| Moderate odors during transport of sludge to compost site - temporary | Moderate odors during transport of sludge to compost site - temporary | |
| Erosion to soil and land currently being excavated in landfill - exact amount not known. | Normal erosion from agricultural land - exact amount not known. | Erosion from construction of 12 lagoons (total volume 1704 million gallons; 6,449,640 $m^3$) and 16 drying beds ($32 \times 10^6$ sq. ft.) |
| Proper landfill design includes impermeable liner to avoid soil contamination. | Composted sludge application rates based on heavy metals limitations. | Lagoons design includes impermeable liner. Leaching of materials in drying beds to lower soil levels is restricted. |
| Of minimal benefit to plants other than trees, because of root depth (24 in.) | Annual application rates based nitrogen (as nitrate) limitation. 3000 lb/acre approximately in top 6" soil. | Not applicable. |
| Of minimal benefit to plants other than trees, because of depth (24 in.) | Beneficial as soil conditioner; dependent on site, but usually improved properties of soils. | Not applicable. |

Table 5.6-B

(continued)

| Impact Category | Incineration and Landfill (3 subalternatives) | Pyrolysis and Landfill |
|---|---|---|
| SURFACE WATER | | |
| Nutrient Contamination | Negligible impacts at landfill site assuming proper controls. | Negligible impacts at landfill site assuming proper controls. |
| Stream Rerouting | Assume all streams would be rerouted around site. | Assume all streams would be rerouted around site. |
| Heavy Metal Contamination | Negligible impacts assuming proper operation. Collection and treatment of runoff would further minimize this impact. | Negligible impacts assuming proper operation. Collection and Treatment of runoff would further minimize this impact. |
| LAND VALUES | | |
| Land Acquisition/Rental | Purchase 260 acres for landfill - total land needed to 2000. All in one township - equivalent to 1.35% of township area. Exact site not chosen. | Purchase 260 acres for landfill - total land needed to 2000. All in one township - equivalent to 1.35% of township area. Exact site not chosen. |
| Land Use Conflicts | No site selected at this time. Potential conflicts depending upon site location and present land use. Some limitations on future use of landfill site. | No site selected at this time. Potential conflicts depending upon site location and present land use. Some limitations on future use of landfill site. |
| Surrounding Land Values | Some limitations on land use may restrict land values, but ultimately use of the site for aesthetic purposes will enhance surrounding land values. | Some limitations on land use may restrict land values, but ultimately use of the site for aesthetic purposes will enhance the surrounding land values. |

Table 5.6-B

(continued)

| Compost and Landfill | Compost and Land Application to Ag. Land | Anaerobic Lagoons and Drying Beds |
|---|---|---|
| Stormwater runoff from compost site discharged to sewers. Negligible impacts at landfill site assuming proper controls. | Stormwater runoff from compost site discharged to sewers. Proper application rate will avoid nutrient contamination. | Potential for contaminated groundwater beneath drying beds to reach surface water because of rapid percolation in sandy soils. |
| Assume all streams would be rerouted around sites. | Assume a buffer zone would be established near streams. | Assume all streams would be routed around sites. |
| Negligible impact at landfill assuming proper operation. Collection of stormwater runoff at compost site. | Impacts unlikely with proper application techniques. Collection of stormwater runoff from compost site. | Not applicable. |
| Purchase 400 acres for composting site and 3,400 acres for landfill - total land needed to 2000. Landfill site equivalent to 14.76% of one township. | Purchase 400 acres for compost site. Rent up to 83,000 acres of existing agricultural land for compost application (total needed to 2000). Exact sites not chosen. | Purchase 2,460 acres existing agricultural land for lagoons and drying beds. Pipeline easement on 250 miles. Exact site not chosen. |
| No site selected at this time. Greater potential conflicts than A and B due to greater amount of land required. Some limitations on future use at landfill site. | No site selected at this time. Crop restrictions to existing agricultural land due to heavy metals in compost. | No site selected at this time. Conflict with existing agricultural land use. Future land use restricted to sludge storage site. |
| Some limitations on land use may restrict land values, but ultimately using the site for aesthetic purposes will enhance the surrounding land values. | No effect if participation in program is voluntary. No effect to lands outside of program, except near the composting site. | Odor will make surrounding land undesirable for residential, commercial or recreational use, thus depressing land values. |

Table 5.6-B

(continued)

| Impact Category | Incineration and Landfill (3 subalternatives) | Pyrolysis and Landfill |
|---|---|---|
| **ECONOMY** | | |
| Fertilizer value of sludge | Not applicable. | Not applicable. |
| Employment generated - primary | 425 jobs with not as many new jobs requiring highly skilled labor as pyrolysis alternative. Proportion of low:high skilled jobs similar to existing situation. | 384 jobs with greater proportion requiring highly technical personnel to operate facilities. |
| **SOCIAL STRUCTURE** | | |
| Disruption of community | Insignificant to the comminity as a whole.<br>Potential to significantly affect a small number of residents causing them to relocate. | Insignificant to the community as a whole.<br>Potential to significantly affect a small number of residents, causing them to relocate. |
| **GROUNDWATER** | | |
| Nitrate Leaching | Impermeable liner designed to minimize leaching. | Impermeable liner designed to minimize leaching. |
| Toxic Materials Leaching | Adequate protection from liner would minimize leaching of heavy metals. | Adequate protection from liner would minimize leaching of heavy metals. |

Table 5.6-B

(continued)

| Compost and Landfill | Compost and Land Application to Ag. Land | Anaerobic Lagoons and Drying Beds |
|---|---|---|
| Minimal - insignificant. | Provides supplemental source of nutrients for 10,000 acres of cropland annually. | Not applicable. |
| 462 jobs with the greater proportion requiring low to moderately skilled labor. | 631 jobs with the greater proportion requiring low to moderately skilled labor. | 107 jobs with the majority requiring low skilled labor. |
| Disruption probable if single site chosen for 3,400 acre landfill. | Few if any relocations required on existing agricultural land. | Few if any relocations required on existing agricultural land. |
| Impermeable liner designed to minimize leaching. | Potential for slight groundwater contamination via leachate, which can be largely controlled by the choice of sites. | Conservative estimate of inorganic nitrate concentrations leaching from drying beds is 200 mg/l. Exceeds drinking water standards for nitrate by 20 times. Extent of leachate impacts not known without further study. |
| Adequate protection from liner would minimize leaching of heavy metals. | Application rates based on heavy metals limitations. | No plans for leachate collection and treatment have been made; toxic materials may also be present in leachate. Extent of leachate impacts not known without further study. |

Table 5.6-B

(continued)

| Impact Categories | Incineration and Landfill (3 subalternatives) | Pyrolysis and Landfill |
|---|---|---|
| AQUATIC BIOTA | | |
| Loss of habitat | Minimal loss of aquatic habitat due to stream rerouting. Approximately .5 miles of intermittent stream occur in any 260 acre site (at the example site).<br>Aquatic habitat lost via wetland removal is more substantial. Approximately 102 acres of wetlands will occur in any 260 acre parcel selected (at the proposed location).<br>These impacts can be largely mitigated by strategic placement. | Minimal loss of aquatic habitat due to stream rerouting. Approximately .5 miles of intermittent stream occur in any 260 acre site (at the example site).<br>Aquatic habitat lost via wetland removal is more substantial. Approximately 102 acres of wetlands will occur in any 260 acre parcel selected (at the proposed site).<br>These impacts can be largely mitigated by strategic placement. |
| Changes in species composition due to runoff | Negligible impact if surface runoff is controlled and buffer zone is maintained. | Negligible impact if surface runoff is controlled and buffer zone is maintained. |
| TERRESTRIAL | | |
| Vegetational loss or disruption | Gradual but temporary loss of cover on 260 acres of landfill. Minimal significance because the sites are typical of abandoned farmland being taken over by native vegetation. Replanting after landfill completion will largely mitigate this impact. | Gradual but temporary loss of cover on 260 acres of landfill. Minimal significance because the sites are typical of abandoned farmland being taken over by native vegetation. Replanting after landfill completion will largely mitigate this impact. |

Table 5.6-B

(continued)

| Compost and Landfill | Compost and Land Application to Ag. Land | Anaerobic Lagoons and Drying Beds |
|---|---|---|
| Will be determined by number and type of stream reroutings on 3,800 acres when site(s) are selected. | Will be determined by number and type of stream reroutings on 400 acres when site(s) are selected. | Will be determined by number and type of stream reroutings on 2,640 acre(s) (4 sections) when sites are selected. Number of stream crossings by pipeline not known. |
| Negligible impact if surface runoff is controlled and buffer zone is maintained. | Impact of surface runoff on aquatic species is minimized by good agricultural practices and adherance to buffer zones. | Impact on aquatic species is dependent upon movement of potentially contaminated groundwater into streams and adherance to buffer zone regulations. |
| Loss of cover on 400 acres composting site for at least the length of study period. Gradual but temporary vegetation loss of cover on 3,400 acre landfill site(s). | Loss of cover on 400 acres composting site for at least the length of study period. | Permanent loss of cover to that portion of 2,460 acres that will become lagoon and drying bed site(s). |

## Table 5.6-B

(continued)

| Impact Categories | Incineration and Landfill (3 subalternatives) | Pyrolysis and Landfill |
|---|---|---|
| Wildlife, Endangered Species | Temporary disruption to some wildlife at landfill. | Temporary disruption to some wildlife at landfill. |
| PUBLIC HEALTH | | |
| Air, Water | Alt. #5 will not meet 24 hr. peak air quality standards for particulates. Other 2 alternatives are within air quality standards. Alt. #5 hazardous to public health. Minimal public contact with approved landfill. | No air quality hazards expected from pyrolysis. Minimal public contact with approved landfill. |
| PUBLIC SERVICES | | |
| Disruption to delivery of service | Some disruption is anticipated from construction at DWWTP and operation at the landfill but no more than normal urban disruptions. Impact is site dependent. | Some disruption is anticipated from construction at DWWTP and operation at the landfill but no more than normal urban disruptions. Impact is site dependent. |
| ENERGY | | |
| Total equivalent energy used BTU/ton dry sludge | Alt. #5 - 8,700,000<br>Alt. #7 - 1,100,000<br>Alt. #9 - 1,100,000 | 1,100,000 |
| Equivalent gallons #2 diesel fuel | Alt. #5 - 60<br>Alt. #7 - 7.6<br>Alt. #9 - 7.6 | 7.6 |
| Other resource commitments | Auxillary fuel requirements #2 diesel (gallons/yr).<br>Alt. #5 - 19,100,000<br>Alt. #7 - 51,700<br>Alt. #9 - 51,700 | Powdered coal needed to condition sludge and provide initial energy for pyrolysis. |
| COST | | |
| Unit cost dollars/dry ton sludge (based on 1064 tons/day dry weight of sludge) | $51 to $99 per ton for 3 subalternatives<br>Alt. #5 - $99<br>Alt. #7 - $63<br>Alt. #9 - $51 | $64/ton |

Table 5.6-B

(continued)

| Compost and Landfill | Compost and Land Application to Ag. Land | Anaerobic Lagoons and Drying Beds |
|---|---|---|
| Temporary disruption to some wildlife at landfill. | Minimal disruption to agricultural land. | Potential disturbance to Kirtland's Warbler at the Lake County site. |
| With proper operation, contact with public should be minimal in compost and landfill operations. | Slight possibility for public contact with composted sludge. | Slight possibility for public contact with sludge because of distance from population centers. |
| Disruptions are anticipated from construction at DWWTP and operation of landfill and composting but no more than normal disruptions. Impact dependent upon site(s). | Disruptions are anticipated from construction at DWWTP and operation of landfill and composting but no more than normal disruptions. Impact dependent upon site(s). | Gradual and temporary disruption from construction of 250 mile (400 km) pipeline, assume 15 ft. corridor. |
| 1,900,000 | 1,300,000 | 7,000,000 |
| 13 | 9.0 | 49 |
| 2.75 cu. yd. wood chips required per ton of sludge for composting. Differing quantities of material needed if corn husks,straw or shredded refuse are used. | 2.75 cu. yd. wood chips required per ton of sludge for composting. Differing quantities of material needed if corn husks, straw, or shredded refuse are used. | Approximately 250 miles (400 km) of 20' diameter sewer pipe and materials to build 50 in-line pumping stations. |
| $80 | $83 | $55 |

## TABLE 5.7-A

## Institution Alternatives, Advantages & Disadvantages

| | METROPOLITAN WASTEWATER AUTHORITY | | DRAINAGE BASIN SUB-REGION | | COUNTY GOVERNMENT | | SINGLE PURPOSE REGIONAL AGENCY | | MULTIPLE AGENCIES (STATUS QUO) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Advantages | Disadvantages | Advantages | Disadvantages | Advantages | Disadvantages | Advantages | Disadvantages | Advantages | Disadvantages |
| IN GENERAL | Facilitates training and management of personnel<br>Economy of scale<br>Coordination is inherent<br>Uniform policy and standards throughout region<br>Not hindered by political boundaries<br>Elimination of existing management barriers<br>Increased administrative efficiencies<br>Easier resolution of conflicts | New institution must be created<br>Requires bureaucracy for management<br>May not be responsive to public and local governmental units or may be too closely tied to original members<br>Minimum local control over rates and capital expenditures<br>Citizens may find themselves less able to influence authority policies than policies of general purpose local government<br>May have problems with existing personnel obligations and retirement benefits | Limited economy of scale<br>Reasonable size for management<br>Reasonable advancement opportunities for technical personnel without changing agency<br>Reduces administrative costs<br>Issues frequently addressed on large geographical or natural boundaries rather than political boundaries<br>Planning and coordinating regions greatly simplified<br>Politically acceptable - local control and policy input maintained (general agency coordinates subagency) | New institutions must be created<br>Region coordination may be difficult<br>Policy and standards may vary throughout region<br>May not be responsive to all elements of public<br>Local control over rates and capital expenditures is indirect | Existing institution utilized-proven record<br>Limited economy scale<br>Responsive to local governmental units<br>Advancement opportunities for technical and managerial personnel within county government<br>Local control over rates and capital expenditures<br>Minimizes administrative costs<br>Geographical scope - logical entities to deal with water quality problems<br>Local municipalities increasingly reliant on county agencies<br>Existing hierarchy for resolution of conflicts | Requires expansion of county activities<br>Regional coordination may be difficult<br>Policy and standards may vary<br>Viewed as mechanism to carry out state policy<br>Do not possess power to initiate projects on their own | Economy of scale<br>Logical form for management<br>Coordination of function is inherent<br>Uniform policy and standards throughout region<br>Not hindered by political boundaries<br>Increased administrative efficiencies<br>Does not pyramid conflicts | New institutions must created<br>Coordination with other activities may be weak<br>May not be responsive to public or local governmental units<br>May not provide adequate advancement opportunities for technical personnel<br>Minimum local control over rates and capital expenditures<br>Possible preoccupation in one functional area - narrows perception and limits response | Existing institutions utilized<br>Management is highly variable<br>Developed historically in response to public demands<br>Local control over rates and capital expenditures is reasonably good<br>Economy of scale - 98% of services provided by 8 operators - wide spread consolidation of services has already occurred<br>Plant operators already possess technical and administrative expertise<br>Easiest to implement<br>Does not disrupt existing personnel obligations and retirement benefits | Coordination is virtually nonexistent - no formal mechanisms concerned with whole geographical area<br>Lacks economy of scale in some elements<br>Policies and standards vary over considerable range<br>Response to public is varied<br>Duplication in potential service areas<br>Political boundaries may hamper logical development and coordination<br>Limited advancement opportunities for personnel without changing agencies<br>Some suburban areas want more local control over rates and capital expenditures<br>Greater overall administrative costs<br>Resolution of conflicts may be difficult |
| FINANCING | Can be a vehicle for additional bonding authority | Difficult to handle - local governments prefer to maintain tight reins on financing - metro district runs counter to this desire<br>Requires initial funding to get started - may have to purchase existing facilities<br>May have to take over existing debt | | Financing difficult to handle<br>Requires initial funding to get started - may have to purchase existing facilities<br>May have to take over existing debt | Financing mechanisms already exist<br>Bond issues - based on county wide property assessments<br>Ability to readily handle short-term indebtedness | Bonded indebtedness limits may become a problem | Can be a method of obtaining additional financing authority | Requires initial funding to get started | Financing mechanisms already exist<br>Tight control over financing | Many need financial relief<br>Bonded indebtedness limits are a problem |
| RATES | Uniformity easily obtained | | Uniformity attainable within subregion | Little chance for regional uniformity | | Little chance for uniformity | Uniformity easily obtained | | | Little chance for uniformity |
| WASTEWATER COLLECTION | | May be too large for practical control<br>May become preoccupied with other problems | Reduces need for pumping and other inefficient practices<br>Economical construction following terrain<br>Reasonable size for practical control | | Reasonable size for practical control | Political boundaries may not produce economical construction units<br>May not give sufficient priority to this activity | Coordination of construction standards<br>Does not become preoccupied with other problems | May be too large for practical control | Maximum local control and responsiveness | Some are too small for practical operation and maintenance |
| WASTEWATER INTERCEPTORS | Facilitates their financing and construction<br>Consistent design parameters can be implemented | | Facilitates their financing and construction | Design parameters may vary | Financing structure available | May require cooperation<br>Design parameters may vary | Facilitates construction<br>Consistent design parameters can be implemented | Financing may be difficult | | Requires close cooperation and coordination<br>Inefficiencies may result from inability to agree<br>Almost impossible to achieve consistent design parameters |
| INDUSTRIAL WASTES | Allows consistent pretreatment standards and enforcement | | | Difficult to achieve consistent pretreatment standards and enforcement | | Difficult to achieve consistent pretreatment standards and enforcement | Allows consistent pretreatment standards and enforcement | | | Virtually impossible to achieve consistent pretreatment standards and enforcement |
| WASTEWATER TREATMENT | Optimization of treatment processes and facilities can be achieved<br>Qualified personnel are more easily recruited<br>Undivided responsibility for achieving water quality objectives | | | May not make optimum utilization of existing treatment facilities<br>Division of responsibility for achieving water quality objectives | Utilizes existing expertise and disperses recruiting | May not make optimum utilization of existing treatment facilities<br>Division of responsibility for achieving water quality objectives | Optimization of treatment processes and facilities can be achieved<br>Qualified personnel may be more readily available<br>Easier to provide special training for technical personnel | | Makes optimum use of existing treatment facilities | May encourage proliferation of small, inefficient treatment facilities<br>Division of responsibility for achieving water quality objectives |
| SLUDGE DISPOSAL | Ability to compare various technical methods | | Less massive problem that may be manageable within subregion | Limited ability to compare various approaches | Less massive problem that may be manageable within county | | Ability to compare various technical methods | | | Little coordination between existing institutions |

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### 5.7.1.1 Metropolitan Wastewater Authority

This institutional arrangement consists of creating a single metropolitan wastewater authority with responsibility for the entire spectrum of wastewater activities. This authority would own and operate the interceptors and treatment plant while leaving the operation and maintenance of the collection system to local governmental units.

The formation of an authority has some very specific advantages over the "status quo" alternative. An authority offers economy of scale, recruitment of qualified personnel without residency requirements, as well as the ability to apply uniform policies and standards throughout the region. Some of the more decisive disadvantages of forming an authority are the inherent problems of creating and operating a new institution, serving multiple political entities, and the initial funding required for its creation particularly if existing facilities must be purchased and existing debts assumed. Enactment of a new state statute would probably be necessary to establish initial funding and to form an authority with well defined powers.

This alternative's value appears particularly great when comparing it to the status quo, when DWSD's problems in managing and operating the regional wastewater treatment system are considered. Therefore, the formation of an authority is considered to have sufficient value to be considered further as a feasible alternative.

### 5.7.1.2 Drainage Basin Subregion

This form of management would involve the establishment of a separate authority for each drainage basin subregion. Each of the subregions is formed by natural drainage boundaries which is applicable to drainage and disposal issues.

The drainage basin subregion arrangement offers a limited economy of scale, real boundaries which would generally coincide with wastewater issues, and probably some reduction in administrative cost over the status quo alternative. However, this alternative has several major shortcomings with only minor offsetting benefits. New institutions would have to be established which could create coordination difficulties between new and existing institutions. The overlapping of political boundaries with drainage basin subregions could make financing a major difficulty. The arrangement would most likely require the new agencies to have initial funding for the purchase of existing facilities and assumption of existing debts.

This institutional arrangement offers limited gain in benefits with several major disadvantages, and is, therefore, eliminated from further consideration.

### 5.7.1.3 County Governments

The existing county governments can be used to operate countywide wastewater disposal systems. This alternative would provide limited economy of scale, existing institutions could be utilized, and responsiveness to local governmental units should be relatively good. The economy of scale will be limited since some cities handle their own wastewater and county activities would have to increase to include coordinating wastewater related activities between the counties and its municipalities. Counties can only require their municipalities to accept wastewater services by contractual agreements, thus, services would be limited by the municipalities desire for the services.

This alternative offers little benefit when compared to the status quo and results in some of the same coordination problems that presently exist. Therefore, this alternative is eliminated from further consideration.

### 5.7.1.4 Single Purpose Regional Agency

This institutional alternative is similar to the metropolitan authority except responsibilities would be more limited in scope. A single purpose regional agency would have to be created to handle wastewater collection and disposal or special problems such as sludge disposal or industrial waste treatment. A single purpose regional agency would have the benefit of economy of scale, administrative efficiencies and uniform policies. However, several major obstacles and disadvantages are inherent in this alternative. Regional agencies are created only by petition of interested municipalities and any expansion of jurisdictional area for the regional agency could occur only by the addition of consenting municipalities. A single purpose agency would have a narrow perception and would need a source of initial funding.

This alternative, while affording some benefits in a narrow framework, has some great obstacles attached to its formations. Thus, this instituional arrangement is eliminated from further consideration.

### 5.7.1.5 Multiple Agencies (Status Quo)

The status quo of the insitutional arrangements consists of multiple agencies providing wastewater collection, treatment and disposal services within the area. Presently, eight governmental units provide 98 percent of the services to the region. There is minimal coordination among agencies and no formal mechanism to control the actions of individual agencies. The SEMCOG point source management study suggests the formation of a regional coordination institution. However, in the Detroit area, some centralized control has existed. DWSD has been effective in controlling the operation of major interceptors while minimizing the impacts on local communities and minimizing stormwater overflows. This amount of centralization should not be reduced.

The major advantage of this alternative is that the institutions already exist and have some administrative and technical knowledge for handling the wastewater systems. Some internal management changes need to be made to enhance the DWSD capabilities for handling the wastewater systems. However, the basic insitutional structure exists and operates and will be considered more extensively.

### 5.7.2 Operation and Maintenance Alternatives

Alternatives for operation and maintenance are presented in the following section. These alternatives have been developed by the facilities planning consultant. The results of this analysis will provide a feasible plan(s) for improvement of operation and maintenance of the DWSD plant.

#### 5.7.2.1 Existing Procedures (Status Quo)

This no-action alternative would mean that the existing problems in procurement time, training, parts inventory, lack of key supervisory personnel, personnel recruitment, and organization and maintenance would be allowed to continue. Some action has already been taken to improve these difficulties and with the DWWTP not meeting its NPDES permit requirement the problem areas must be rectified. It is the opinion of both the facilities planning consultant (Giffels/Black and Veatch, 1977, Book XVII) and EPA, that even with upgrading of physical facilities, the DWWTP cannot reliably meet its effluent limitations without improved operation and maintenance procedures. The consent judgment has already required improvement and continued emphasis upon improving DWSD's O&M operations. Therefore, the existing procedures are not feasible.

#### 5.7.2.2 Improvements to Existing Procedures

This alternative is to utilize the existing facilities and institutions but optimize their operations. A number of recommendations have been made by the facilities planning consultant (Giffels/Black and Veatch, 1977, Book XV) for improving the operations of the existing system. The primary recommendation is that DWSD remain as the primary wastewater agency in the study area, but that DWSD be provided with much more autonomy. Some secondary recommendations include:

- Establishment of a strong internal training program; and
- Reorganization of DWSD to place existing talent in the most critical areas.

Most of the improvements will occur as a result of the consent judgment; therefore, this alternative is partially implemented. The remaining recommendations should be considered as a feasible alternative.

### 5.7.2.3 Contract for Operation and Maintenance

The arrangement would mean DWSD could, on a permanent or temporary basis, contract with a private enterprise or with an outside agency for operation and maintenance. This option offers the opportunity for a highly technical and business minded organization to run the DWSD treatment plant. This has been done for specialized equipment such as the computer but substantial obstacles exist for the implementation on a large scale. There is no precedent for an operations and maintenance contract of this magnitude. There would be serious questions on what performance standards are necessary and the structure of the contract. The nature of operating a wastewater treatment plant requires minimizing present costs to meet permit requirements, yet providing sufficient maintenance to mechanical equipment to allow an economic useful life. Such balancing of long-term vs. short-term costs would be difficult to incorporate into a management contract. There would be the possibility for disruption of service at the end of a contract, and communities would have to approve such an arrangement.

This option on a limited scale or for specialized equipment is feasible. However, for the scale of DWSD, this alternative is not considered feasible and will be dropped from further consideration as a long-term solution.

## 5.8 Summary

Collection and treatment alternatives were analyzed separately from residuals disposal alternatives in this chapter. A three phase analysis was used to (1) identify possible components of the system, (2) combine the system components into alternatives for screening to determine the feasible alternatives, and (3) evaluate the feasible alternatives to arrive at a recommended plan. Section 5.3.3 summarizes the evaluation of the four feasible collection and treatment alternatives. Section 5.6.3 summarizes the evaluation of the residuals disposal alternatives. Institutional alternatives are evaluated in Section 5.7 as are operation and maintenance alternatives. The results of these separate evaluations will be brought together as an entire recommended plan in Chapter 6.0.

## 6.0 RECOMMENDED PLAN

The recommended plan is described in this section. The description includes a discussion of the selection process and compares the recommendations of the facilities planning consultant to U.S. EPA's position concerning certain specific elements. The section concludes with a discussion of the Future Studies required in the facilities planning process.

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## 6.0 RECOMMENDED PLAN

### 6.1 Selection Process

The recommended plan is a consensus plan. It is the result of compromises by EPA, MDNR, and DWSD, each of which has different "publics" as their primary concern. The plan does not solve all pollution problems and therefore it is not a final plan. Further study, additional analysis, and the continued cooperative involvement of all parties is required.

The plan was developed after the OP/EA was drafted and a hearing was held on the recommendations of the OP/EA. The formulation of the recommended plan within this segmented facilities plan involved negotiations prior to the signing of a Consent Judgment and discussion between the U.S. EPA, MDNR, DWSD, SEMCOG, Wayne County Air Pollution Control Division, the facilities planning consultant, and the EIS consultant.

#### 6.1.1 Overview Plan (Draft)

The OP/EA presented recommendations which provided for improvements to the DWWTP to allow for optimum operation of the existing facilities. The recommendation was a hybrid of alternatives B and C. This included the construction of the "Givens" discussed in Sections 1.0 and 3.0; upgrading and redesign of existing facilities, and major system improvements to provide 2300 mgd primary treatment. Residual disposal was to continue to utilize incineration as a volume reduction technique, and included the construction of Sludge Complex III and tall stacks. A 100 ton/day pyrolysis plant was recommended as a pilot project.

Collection system improvements included the construction of major relief sewers, retention basins, and the Lakeshore Arm, the Romeo Arm, the Armada Arm, and the Richmond Arm in the Oakland-Macomb district. Management and staffing changes were included to improve operations and maintenance operations.

At the hearing on the OP/EA, questions were raised by U.S. EPA and MDNR which required reanalysis of data. The major issues raised included: the method of air quality modeling; the introduction of separate sanitary waste into combined sewer interceptors, which is prohibited by Michigan law; and the sufficiency of data required to make decisions concerning the control of CSO.

#### 6.1.2 Consent Judgment

The Consent Judgment negotiated on September 9, 1977, and signed by DWSD, MDNR and U.S. EPA (Appendix 11.8) impounded $399,055,250 of the Federal construction grants program dollars and placed several requirements on DWSD. The issues addressed in the Consent Judgement include:

- Financing. The Consent Judgment details a schedule by which DWSD must have developed various portions of a continuing revenue system. This includes a user charge system, an industrial cost recovery system, a sewer ordinanace, and a local capital cost funding system;
- Industrial Waste Control. A schedule for implementation of an industrial waste control plan is detailed in the Consent Judgment;
- Staffing, Training, Operation and Maintenance. A schedule is provided for the implementation of DWSD's staffing plan and training program. An O & M manual is to be prepared and specific details are outlined for operation and maintenance, and for procurement;
- Facilities Planning. A schedule for the completion of the segmented facilities plan and the final facilities plan is described;
- Sludge Disposal. The steps required and the timing of interim and final sludge disposal plans are outlined;
- Secondary Treatment. A description of and the schedule for the contracts required to obtain secondary treatment by 1980 is outlined;
- Phosphorus Removal. Target dates for the construction required to reach a one milligram per liter phosphorus limits by 1982 are outlined; and
- Effluent Limits. Staged improvements in effluent between 1978 and 1981 are described.

### 6.1.3 Resolution of Issues

During the months from July 1 through November 30, 1977, meetings were held to resolve those issues. Parties to the discussions includes representatives of the following organizations:

DWSD
U.S. EPA, Water Division
U.S. EPA, Air Division
MDNR
Wayne County Air Pollution Control Board
facilities planning consultant
EIS Consultant

The issues discussed included the wastewater treatment plant site plan, air quality, sludge disposal, and the West Arm.

### 6.1.3.1 Wastewater Treatment Plant Site Plan

The OP/EA recommended expansion of the treatment plant site into an area north of the existing site. New primary treatment with a capacity of 2300 mgd was recommended. Following the hearing, DWSD informed the facilities planning consultant that expansion to the north would violate a city council policy which discouraged conversion of residential land to public uses. Several alternative site plans were then developed which allowed for expansion to the west of the existing site on land presently used by industries.

The Consent Judgment changed the requirements of the OP/EA. The OP/EA was modified to develop a segmented facilities plan for the treatment plant with a secondary capacity of 1050 mgd. The revised plan for the plant did not require expansion of the site, but the facilities planning consultant noted that a better layout would be possible if additional land was available.

### 6.1.3.2 Sludge Disposal

The OP/EA recommended the construction of the third incineration complex. The basis for the recommendation was that the complex was a "given", the incinerators in Complexes I and II have a limited useful life, and the sludge from the recommended new primary would tax the capacity of Sludge Complexes I and II. The change in emphasis from an overview plan to a segmented facilities plan required that sludge volumes be recalculated. During the reanalysis, it was determined that for average flows, the rated capacity could be obtained with improved operation and maintenance of the existing vacuum filters and incinerators. Additional capacity for sludge disposal or storage is required to cope with the sludge produced during maximum flow (1050 mgd) periods. This will be addressed as a part of the permanent residuals disposal program and will be studied under contract CS-823.

### 6.1.3.3 Air Quality

In August, 1976, the City of Detroit entered into a Memorandum of Understanding with the Wayne County Department of Health to modify the existing incinerators to ensure compliance with the particulate emission limitations and improved particulate dispersion. This agreement has since been reexamined in lieu of anticipated wastewater charges,O&M charges and revised incinerator capacities. By utilizing a standard gaussian diffusion model, Giffels/Black and Veatch determined that air pollution standards could be met by:

- Continued construction of the improved emissions abatement system for Complex I per PC-400 to achieve emissions equivalent to New Source Performance Standards;

- Provide stack gas reheat to 300°F. to preclude induced draft fan deterioration and increase plume buoyancy;
- Increase gas exit velocity to 4500 feet/minute; and
- To renegotiate the 250 foot tall stacks requirements to allow a 146 foot minimum stock height.

It is further recommended that DWSD engage a consultant to:

- Determine the optimum combination of exit temperature, exit velocity and height; the existing short stacks can be extended with nozzles; and
- Pilot test the retrofit of an existing incinerator to separate the drying zone and burning zone, extract the exhaust gases from the burning zone through an unfired external afterburner and employ heat recovery to preheat the combustion air and reheat the exit gas stream. The pilot test period will also provide the opportunity to evaluate the effectiveness of the venturi scrubbers installed in Complex I prior to making any modifications to the emissions abatement system of Complex II.

These recommendations and a strict schedule of implementation (see Appendix 11.1) have been agreed to by MDNR, U.S. EPA, DWSD as well as the Wayne County Department of Health Air Pollution Control Division, and supersede the 1976 MEmorandum of Understanding.

### 6.1.3.4 West Arm Interceptor

The near drought conditions which occurred during the first portions of the study and the limited available data did not provide sufficient data for U.S. EPA to make a decision concerning the West Arm. Therefore, U.S. EPA cannot support that element of the recommended plan until such time as sufficient data is available to determine the water quality benefits of the interceptor.

The interceptor remains a part of DWSD's plan in order to comply with the Michigan law which does not allow separate sanitary sewage to be comingled with combined sewage. Construction of the interceptor was requested by Oakland County at the OP/EA public hearing as a means of increasing their outlet capacity to the DWSD system and eliminating the direct overflow of sewage to the River Rouge during rainfall events. Construction of the interceptor is also supported by SEMCOG.

## 6.2 Description of the Recommended Plan

This section presents a brief outline of the recommendations presented by the facilities planning consultant. Technical details of the recommended plan can be found in the SFP (Giffels/Black and Veatch, 1978, Book I).

A number of programs are proposed for the SFP which can be grouped in the following categories:

- First Category (1977-1981) Optimization of Existing Facilities;
- First Category (1977-1981) New Major Construction Programs; and
- Continuing Programs.

The descriptions presented in this section are taken from the SFP (Giffels/Black and Veatch 1978, Book I).

### 6.2.1. First Category (1977-1981) Optimization of Existing Facilities

The objective of First Category work is rehabilitations of the existing facilities to eliminate problems which have plagued past operations.

#### 6.2.1.1 Primary Treatment

- Modify scum building serving rectangular clarifiers to include a portable scum container. This scum container will allow either hauling scum to off-site disposal or pumping from the container to present scum handling facilities;
- Redesign and replace scum removal arms in circular clarifiers A1 and A2. After placing the proposed primary tanks A3 and A4 in service, additional modifications to A1 and A2 include the redesign of the scum beach and the scum hopper depending upon A3 and A4 performance;
- Replace electrical equipment and controls for rectangular clarifiers. New equipment is to be isolated from pipe tunnel atmosphere to eliminate equipment for explosionproof equipment; and
- Based on the results of primary sludge verification studies modify primary sludge piping.

#### 6.2.1.2 Secondary Treatment

- Modify peripheral influent lines in final clarifiers based on performance and testing on one unit;

- Provide new cable and raceways for cables at intermediate lift pumps 1 and 2;

- Modify electrically operated discharge valves in sludge lines with mechanical check valves in buildings B1, B2, B8, B10, and B14;

- Provide a centrally located ventilation failure alarm for final clarifier buildings, and ventilation facilities for the aeration tank buildings;

- Renovate aeration tank gates used to maintain liquid level in the aeration tanks; and

- Seal $O_2$ aeration tank #1 deck.

#### 6.2.1.3 Disinfection

- Provide improvements to existing chlorine feed system to assure reliability. Provide leak detection device with alarm in feed room.

#### 6.2.1.4 Phosphorus Removal

- Provide new chemical feed pumps in existing chemical feed building and piping to temporarily feed to influent pump suction lines. Provide temporary mixers at the collection channel downstream of the original grit channels;

- Replace existing flow metering equipment and control valves in pickle liquor storage and feed system; and

- Provide engineering studies for flocculation to enhance phosphorus removal.

#### 6.2.1.5 Sludge Treatment

- Replace mechanical mixing system in one blending tank with an air mixing system. Replace two constant speed blending tank pumps with variable speed units;

- Modify piping to improve flexibility in operation of sludge thickening, blending, and storage facilities;

- Provide sludge thckening complex main control panel renovation, ultrasonic generators for cleaning magnetic flowmeters, and air filters and dryers on vacuum filter instrument air;

- Conduct pilot test coaluation of test scale and full scale filter presses to arrive at desired configuration for additional sludge disposal facilities;

- Optimize operation of existing vacuum filters by use of conditioning and/or filter aids; and
- Provide additional interim dewatering facilities to allow modification of existing facilities while handling all sludge generated within the time stipulated in the Consent Judgment.

#### 6.2.1.6 Sludge and Grease Incineration

- Continue construction of emission devices for Sludge Complex I per PC-400;
- Replace oxygen analyzers and calibrate existing incineration instrumentation in Sludge Complex II;
- Repair the scum and grease incinerator and rectify deficiencies. If grease is incinerated satisfactorily then provide emission controls;
- Consider or continue pilot studies for gas stream retrofit of one incinerator in Sludge Complex II to achieve autogenous burning; roller press on existing vacuum filters; addition of powdered coal as a filter aid; use of filter press; various incineration techniques for disposal of sludge, grease and scum; and use of scum and grease in sludge incinerators as auxiliary fuel; and
- Provide stack gas reheat and increase gas exit velocity.

#### 6.2.1.7 Solids Handling

- Rebuild sludge handling conveyor system in Sludge Complex II to provide redundancy and reliability;
- Renovate the ash handling system in Sludge Complex II by separating west ash system from dry ash system;
- Renovate ash storage silo discharge to provide closed feed to covered trucks;
- Rebuild sludge handling system in Sludge Complex I in accordance with PC-400;
- Complete grit studies under Contract CS-816 and implement recommendations;
- Provide improved weighing system; and
- Provide ash volume measurement.

### 6.2.1.8 Flow Measurement and Sampling

- Modify existing venturi meters and flow control gates on the four primary influent conduits;
- Provide flow metering and sampling capability in recycle piping from incinerator scrubbers, vacuum filters, and sludge thickeners;
- Modify flume from intermediate pumping station into the aeration tanks 1 and 2 with open channel flow metering devices and place samplers at these locations;
- Provide sampling lines and sinks to sample primary sludge from each clarifier;
- Improve existing raw wastewater sampling stations and renovate other sampling stations as required;
- Provide engineering studies for DWWTP effluent flow measurement; and
- Provide engineering studies for metering influent flow in DRI and O-NWI.

### 6.2.1.9 Maintenance and Plant Staffing

- Provide preventive maintenance for electrical equipment and controls of main pumping station, screen racks, grit collectors, and other areas;
- Implement proposed maintenance program and provide chain of command with specific areas of responsibility;
- Determine areas where contract maintenance could be justified when compared with in-house maintenance;
- Implement proposed organization, training, and staffing program to provide adequate supervisory structure; upgrade existing level of worker competence with an ongoing training program; and provide an ongoing entry level training program; and
- Develop and implement system for inventory control and build up.

### 6.2.1.10 Miscellaneous Improvements

- Completion of all "Given" contracts (see section 1.0) except Sludge Complex III as presently set forth in PC-295 and except "Tall Stacks" as set forth in CS-802;
- Construct clarifiers A3 and A4 as described in Construction Contract PC-276 to provide adequate primary clarification capacity to treat 1050 mgd peak flow and to satisfy timing requirements of the Consent Judgment. It is anticipated that a new primary system may be

constructed in the future and that the existing primary system (excluding tanks A1 and A2) would then be available for combined sewage overflow treatment, as required; and

- Provide central laboratory for DWWTP and industrial waste monitoring program.

### 6.2.1.11 Interceptor Sewers

- For optimization items see Construction Programs;
- Study existing combined sewer regulators and backwater gates and design improvements; and
- Design in-system storage devices.

### 6.2.1.12 Financing

In accordance with rate increase policy initiated August 1, 1977, an interim rate increase was established and additional rate increases will be put into effect in 1978 and 1979. The revenue created by this rate increase will finance the First Category Construction and Optimization Program.

During this interim period the following work will be performed for incorporation into a permanent rate model:

- User Charge and Industrial Cost Recovery, in accordance with Consent Judgment and Local Capital Cost Funding program; and
- Local Capital Cost Funding, in accordance with DWSD program for permanent rate model and with Consent Judgment.

### 6.2.1.13 Management

- Staffing. Upgrade number and capabilities of staff for treatment plant and collection system. Particular emphasis should be on supervisory personnel for 24 hour operation;
- Training. Establish stronger internal training program. Recognize that a massive ongoing training program is required in order to retain an adequate number of skilled staff;
- Personnel Recruitment. Make greater efforts to recruit and retain qualified supervisors and skilled tradesmen. The recruiting and retention of qualified personnel must be assured by aggressive recruitment using all resources to draw personnel from the widest pool of potential employees;

- Purchasing. Improve purchasing procedures. Increase direct purchase limit through revision in ordinance. Consider transferring some purchasing authority to DWSD by ordinance as provided in the City Charter;

- Construction Management. Contract some construction management services to conserve middle management staff for other duties; and

- Operation Review. Increase opportunities for communication between designers and operating personnel.

6.2.1.14 Institutional

- Contract Modifications. Develop changes in existing sewage disposal service contracts to improve ability to meet changing conditions as defined in the SFP and provide for installation of low metering and control devices at points of connection with the DWSD system;

- Waste Control Ordinances. Develop more detailed and enforceable ordinances as required by regulatory agencies;

- Disinfection. Review requirement for disinfection in the light of the receiving waters use; and

- Effluent Limitations. Be prepared for changes by maintaining flexible planning posture.

6.2.1.15 Industrial Waste Control

- Implement an industrial wastewater control program based on pretreatment at the source in accordance with the City Ordinance administered by DWSD. The industrial waste control program will be in compliance with the pending "Pretreatment Standards for Existing and New Sources of Pollution" guidelines to be published by the U.S. EPA; and

- Organize and staff the DWSD Industrial Waste Control Section as proposed or as may be required to implement pending U.S. EPA "pretreatment standards".

6.2.2 First Category (1977-1981) New Major Construction Programs

6.2.2.1 Treatment Plant

The new facilities contained in this section are designed to improve overall plant operation and phosphorus removal. For the purpose of design of facilities for 1981, the average dry weather flow is 600 mgd and the peak flow (assumed sustained for 48 hours maximum) is 1050 mgd.

- Construct a new 2,350 mgd (firm capacity) raw wastewater pumping station. The initial firm capacity will be 1300 mgd. This pumping station will separate West Arm and East Arm Interceptor flows from DRI and O-NWI flows. The pumping station will also contain raw wastewater screening, grit facilities and flow measurement equipment;

- Construct a new disinfection facility with the capacity to supply 10 mg/l of chlorine to a flow of 1,050 mgd, with provision for expansion;

- Expand laboratory into abandoned chlorination facilities area;

- Construct a new chemical building for phosphorus removal. This building will contain storage, transfer and feeding facilities for iron (both ferrous and ferric) and polymer. Provide temporary iron and polymer feed lines from this building to the original pumping station and preliminary treatment facilities. First stage chemical building will be designed with firm capacity to treat 1,050 mgd;

- Provide an addition to the existing maintenance building and provide facilities for light maintenance of non-affixed equipment including vehicles;

- Construct sludge blending and storage tanks proposed in PC-295;

- Provide additional dewatering units;

- Construct ash lagoons to provide space for proposed pump station.

When this construction and the First Category optimizations are completed the plant will be operated in the following manner:

- Due to the scheduling of interceptors and the new pumping station, an interim operation plan must be provided to continue complete treatment of dry weather flows and overflow of combined wastewater brought to the plant in excess of 1,050 mgd. This plan may include double pumping of flows received from the new pumping station to the existing pumping station plus closure of remote regulators to the East and West Arms during wet weather flows;

- Ferrous and ferric iron from the new chemical building will be added at the original raw wastewater pumps, and polymer, also from the new chemical building, will be added downstream of the original grit channels. The exact chemicals, dosages, and addition points will be determined by studies conducted under contract CS-822;

- Secondary treatment will receive flow from the primary clarifiers up to a maximum of 1,050 mgd. Due to primary clarifier optimization and the construction of the new chemical feed facilities, the phosphorus level in the secondary effluent should be 1.0 mg/l or less in this period. It may also be beneficial to feed iron salts to the secondary influent as determined by CS-822;

- Recycle flows from the sludge treatment processes may continue to flow to the original pumping station as determined by CS-822; and

- Based on the results of the primary sludge study primary sludge from the circular and rectangular primary clarifiers should be gravity thickened or sent directly to the sludge blending tanks. All waste activated sludge should continue to undergo gravity thickening.

### 6.2.2.2 Interceptor Sewers and Combined Sewer Overflow Systems

- North Interceptor, West Arm (NI-WA). Construct the North Interceptor, West Arm (NI-WA) to provide interceptor capacity to western Detroit, portions of the western and northern suburbs, and reduce combined sewer overflows to the River Rouge. This construction will allow the western interceptor system to comply with the MDNR policy that sewage from areas having separate sanitary sewers shall not be discharged with combined sewer overflows. The U.S. EPA does not concur with the facilities planning consultant's recommendation concerning the NI-WA and feels that sufficient data has not been developed to determine the benefits of this recommendation;

- Detroit River Interceptor Relief (DRI-R). To reduce combined sewer overflows, a force main and gravity interceptor will relieve a bottleneck in the DRI between the Connors Creek pumping station and Helen Avenue. The routing parallels the existing interceptor. There will be six construction access points to the tunnel. The tunnel length will be about 14,200 feet (4300 m) long and 48,000 $yd^3$ (36,700 $m^3$) of excavation will be removed;

- Oakwood-Northwest Interceptor Relief (O-NWI-R). A 6 ft. diameter relief sewer will relieve a bottleneck in the Oakwood-Northwest Interceptor between McNichols Road and Puritan Avenue. This relief will be constructed by tunneling parallel to the existing interceptor. Two access points are anticipated for this tunnel which will be 2500 ft. long. About 3600 $yd^3$ (2700 $m^3$) of excavation will be removed;

- Pumping Station Improvements. The Connors Creek Pumping Station will be upgraded through electrical improvements and renovation, and installation of a new 90mgd sanitary sewage pump. The station will be connected to the Detroit River Interceptor Relief, which provides a bypass of the Fairview Pumping Station.

  The Oakwood Pumping Station will also be improved by adding two new 100 mgd pumps and renovating the oil skimming facilities.

  Install a new 300 cfs pumps at the Bluehill Pumping Station.

  All improvements to the Connors Creek and Oakwood Pumping Stations will be within the existing structures. No new land acquisition is needed.

- Fabridam Installations. Fabridams, which may increase insystem storage, along with instrumentation controls, will be installed at:

  Telegraph Road and Puritan Avenue
  Seven Mile Road and Shiawassee
  Frisbee and Woodbine Avenue
  McNichols Road and Bramell Street (McNichols Relief outfall)

  Construction areas for fabridam installation will be 20 x 20 x 30 ft. (6 x 6 x 9 m).

- Sluice Gate Installations. Sluice gate instrumentation and remote controls, will be installed to increase insystem storage for the Wyoming Relief at the intersection of Kercheval and Manistique. Construction areas will be approximately 20 x 20 x 30 ft. (6 x 6 x 9 m);

- Ashland Sewer Bulkhead and Flow Diversion. The Ashland Sewer will be bulkheaded immediately upstream of the Fox Creek Backwater Gate Structure. Flows will be diverted either by constructing a drop manhole at the intersection of Kercheval Avenue and Ashland Street to route flow from the Ashland Sewer into the Fox Creek Relief Sewer, or by constructing about 300 feet of tunnel to the Manistique Sewer;

- Suburban Interceptors. The following interceptors will be constructed: Mt. Clemens Arm, Lakeshore Arm (Joy to 21 Mile Road), and Richmond Arm (21 Mile Road, Gratiot to I-94); and control facilities for Mt. Clemens and NE Clinton Township, for Clinton Township at 15 Mile and Little Mack, for Fraser at 15 Mile and Hayes, for NE Shelby Township, and for Chesterfield Township at 21 Mile Road and I-94; and

- System Control Center. Determine the needs of the System Control Center to adequately perform its function when the additional facilities designated herein are completed. Revise, expand, and/or relocate the System Control Center as may be necessary to achieve operational efficiency.

### 6.2.3 Continuing Programs

#### 6.2.3.1 Treatment Plant

No new continuing programs are listed for the treatment plant; see Optimization Programs. The continuing programs identified in First Category (1977-1981), Optimization of Existing Facilities, shall be continued.

#### 6.2.3.2 Collection System

Continue the established program of repair, replacement, and relief of lateral sewers. A annual budget item should be provided for this general work.

Continue the established program of sewer maintenance which is to include the monitoring and remote control system. This is an annual budget item.

#### 6.2.3.3 Management

- Training. Long-range training programs to provide proper operation and upward mobility within DWSD; and
- Review. Periodically review and evaluate the effectiveness of ongoing activities.

#### 6.2.3.4 Institutional

- Contract Modifications. Periodic updating of agreements; and
- Areawide Cooperation. Work closely with other area wastewater utilities in solving common problems.

#### 6.2.3.5 Public Relations

- Public Meetings. Carry message of DWSD to the customers;
- Media. Utilize the media to tell a positive story; and
- Industrial Waste Cooperative. Involve industry in meeting proposed industrial waste limitations.

## 6.3 Unresolved Issues

As discussed in section 6.2.2.2 the facilities planning consultant and DWSD have recommended the West Arm of the North Interceptor be constructed. Due to the lack of date on combined sewer overflows which the West Arm is designed to reduce, the benefits of this proposal cannot be determined at this time. Program Requirements Memorandum 75-34 requires that the benefits to the receiving waters be analyzed for a range of levels in pollution control and the costs of the plans are commensurate with the benefits derived.

The final facilities plan includes a detailed study of the River Rouge CSO, and creation of a model to predict the response in the River Rouge to varying conditions. The model, when established and verified, will provide the required estimate of water quality benefits for the available alternatives. The completion of this analysis will permit a decision to be made by U.S. EPA as to the eligibility of the proposals for Federal Funding under PL 92-500.

## 6.4 Future Studies

The SFP and this EIS represent a part of the studies relating to the DWSD system. The Consent Judgment (Appendix 11.8), PL 92-500, and NEPA all require various documents and information contained in projects such as these.

The studies that are the subject of this section are portions of the facilities planning process of PL 92-500. However, the studies are items specified in the Consent Judgment. During the negotiations of the Consent Judgment certain items were singled out as requiring special emphasis.

While the special studies mentioned in the Consent Judgment are not the entire nor most important elements of any facilities plan, all of the elements of a facilities plan contribute to the recommended plan of action, each contributing to a logical thought process that results in the final recommended plan (Appendix 11.1 Outline of Facilities Plan).

Among the requirements of the Consent Judgment are the completion of the segmented and final facilities plans. The segmented facilities plan is the subject of this EIS (Section 1.0) as required by NEPA and implemented by U.S. EPA. The final facilities plan will have an EIS prepared as stated in correspondence from the Water Division Director of U.S. EPA, Region V, to the Director of DWSD on October 20, 1977.

The following discussion groups the future studies by their source. There are four sources: (1) requirements of all facilities plans, (2) special studies part of the SFP and/or current studies, (3) final facilities plan studies, and (4) reports required to satisfy the requirements of NEPA. These studies are discussed in more detail in Appendix 11.1.

### 6.4.1 Facilities Planning Studies

The facilities planning process specifically requires that an O & M manual, sewer use ordinance, user charge and industrial cost recovery systems and industrial waste control program be in force before final completion of any facilities plan.

An O & M manual is required for all facilities constructed under the FWPCS (40 CFR 35.925-10) and specifies the procedures necessary for adequate maintenance and operation. Normal and extreme operation procedures are to be presented along with the periodic maintenance necessary to assure that the facilities' performance conforms with its design.

Sewer use ordinances limit the type and design of connections to public sewers (40 CFR 35.927-4). The ordinance is required to prohibit new sources of inflow from being connected to the sewer system and ensure that new connections are properly designed and constructed.

The user charge and industrial cost recovery systems are required to fund the local share of the facilities cost (40 CFR 35.925-11). The industrial cost recovery system retrieves the capital costs attributable to industrial users. User charges provide funding for the local share of the facilities cost and the operation and maintenance costs.

A local capital cost funding study is a portion of the user charge/industrial cost recovery system. However, the Consent Judgment specifically calls for a report detailing the source of funding for the local share of the facilities cost.

The industrial waste control program is designed to enforce existing local, state, and federal regulations (PL 92-500-Section 308-C) and to monitor industrial discharges to the sewer system. The monitoring assures equitable user charges based on flow and flow characteristics. Flow characteristics include sampling for toxic pollutants and/or constituents which may adversely affect the facilities operation. The goal of this program is to reduce toxic and/or adverse pollutant discharges to the system.

### 6.4.2 Special Studies

The special studies have been identified by the Consent Judgment as items needing immediate attention.

The final clarifier study is required to permit upgrading of the final clarifiers' performance to design parameters. Problems with the clarifiers' design necessitate some modifications. This study is to determine requisites for improving the final clarifiers' performance. A portion of this study will be performed under contract CS-822.

### 6.4.3 Final Facilities Plan Studies

The final facilities plan comprises many elements (Appendix 11.1, Outline of Facilities Plan), some of which were specified in the Consent Judgment. While the following studies are important components of the facilities plan, equally important segments of the plan were not mentioned. A few components of the facilities plan not mentioned include a sludge disposal program for any additional sludge above the 1050 mgd plant, a forecast of future flow and waste load, the evaluation of the future interceptor repair and replacement needs, a stormwater management plan, and an energy conservation evaluation.

The Consent Judgment specifically requires a CSO study. The CSO study will determine the volume and water quality of the CSO. This study will provide a quantifiable estimate of needed improvements for a stormwater management plan.

A study to determine the capacity and capability of the existing plant is required by the Consent Judgment. This study will determine both the hydraulic capacity of the plant and the constraints limiting that capacity. The capability of the plant to treat a given hydraulic capacity of wastewater will also be evaluated to determine what problems need to be corrected to meet the NPDES permit limitations. The information regarding the existing plant will determine what additional measures are required to meet future demands upon the DWWTP.

The influent and flow characteristics study required in the Consent Judgment is to determine the present flow to the DWWTP and its characteristics. The flow and characteristics of flow will allow more precise determination of the needs of the DWWTP and will allow refinement of the true capacity and capability of the plant.

The Consent Judgment states that the facilities required be identified and described in advance of the final facilities plan completion. That interim report published prior to the final facilities plan will outline the facilities required to satisfy the DWSD needs for the planning period.

An integral part of the facilities plan, the environmental assessment is also required by the Consent Judgment. The environmental assessment will outline current conditions, evaluate the proposed alternatives including "no action", and describe the environmental impacts of the recommended plan.

Each of the studies discussed in Section 6.4.3 will be published as an interim report. The purpose of these interim reports is to allow review and negotiation of the issues that will be a part of the final facilities plan report.

### 6.4.4 NEPA Reports

The environmental assessment required as a part of the final facilities plan is a portion of the NEPA requirements as implemented by U.S. EPA.

The final facilities will require an EIS to fulfill the requirements of the federal government.

The final EIS will address several important issues already identified, and others as necessary. Issues identified at this point include selection of landfill site for ash disposal, north Macomb County sanitary needs survey, and a DelRay neighborhood analysis to include odor problems. Additional issues that will be addressed include plant expansion beyond the existing site, stormwater management and the current incinerator pilot studies.

## 6.5 Summary

The selection process and recommended plan were described in this section. Recognition of both the facilities planning consultant's and U.S. EPA's views are made. The Further Studies section briefly outlines the unresolved issues of this SFP that will be answered in the final facilities plan. The specifics of the recommended plan will be used to estimate impacts in Chapter 7.0.

## 7.0 IMPACTS OF THE RECOMMENDED PLAN

This chapter presents the environmental impacts of the recommended plan upon the future environment of the area. The severity and duration of the impacts are discussed and evaluated. The impacts of the collection and treatment system recommendations have been separated from the sludge processing and disposal recommendation. This analysis incorporates the information developed in the preceding chapters of this statement. Information developed in this chapter will be the basis for the Chapter 8 discussion of long-term versus short-term considerations.

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# 7.0 IMPACTS OF THE RECOMMENDED PLAN

## 7.1 Treatment and Collection Impacts

### 7.1.1 Climate

The proposed collection and treatment system will have no discernible primary impact upon the climate in the study area.

### 7.1.2 Geology and Topography

The geology of the study area should not be impacted by the proposed plan. Tunneled sewer construction will occur in areas of unconsolidated glacial lake plains and will not likely reach bedrock. Grading and major construction work along the interceptor routes will temporarily impact the existing urban topography.

The site chosen for the one demonstration CSO control structure will receive both short and long-term primary adverse impacts. The site location will determine the degree and type of impact. Impacts will be more severe and mitigating measures more imperative if a wooded park site is chosen over an "eyesore" vacant area.

The excavation of tunneled sewers, cut and cover sewers and the CSO control structure will create nearly 2.0 million cubic feet (56,600 $m^3$) of spoil. Disposal of this spoil in a haphazard, uncontrolled manner will cause significant long-term, adverse impacts.

### 7.1.3 Soils

The soils of the area will be minimally impacted on an areawide basis by the recommended plan. However, construction may cause localized adverse, short-term impacts. Potential soil erosion damage exists at the following small construction locations in the study area:

Three pumping station expansions

- Conners Creek;
- Bluehill; and
- Oakwood.

Eight flow control facilities involving 20' x 20' x 30' excavation:

- Mt. Elliott and Gratiot (NI-EA);
- Meldrum and Gratiot (NI-EA);
- Stimson and Fourth (NI-EA);
- Mt. Clemens;
- N.R. Clinton Township;
- 15 Mile and Little Mack (Clinton Township);
- 15 Mile and Hayes (Fraser);
- N.E. Shelby Township; and
- 21 Mile and I-94 (Chesterfield Township).

Three service gates of approximately 20' x 20' x 30':

- Kirkwood and Lonyo (Wyoming Relief);
- Joy Road and Livernois (Upper Livernois Relief); and
- Kercheval and Manistique (Ashland Relief).

One sewer bulkhead approximately 20' x 20' x 30':

- Ashland Sewer.

Other areas of potential erosion are the DWWTP where construction of new buildings and facilities will occur, the site of the one pilot CSO control structure, the 15 one-acre access sites needed for 35,700 linear feet 10,880 m) of tunneled sewer construction, and the spoil disposal site(s).

Eroded material will either be washed directly into local streams and rivers, or more likely, because of the urbanized nature of the study area, will be carried into combined sewers. This sediment burden clogs sewers and regulators, reduces sewer capacity, and puts an additional strain on treatment facilities at the DWWTP. Where sewer capacities are exceeded and overflow points exist, this sediment may be discharged into the major rivers aggravating the adverse impacts of CSO to water quality. These impacts are insignificant when compared to erosion impacts from the Detroit urban area. Residential, commercial, and industrial construction probably contribute a far greater erosion impact than that of the proposed construction.

### 7.1.4 Hydrology

#### 7.1.4.1 Surface Water Quantity

A beneficial impact of the proposed collection system will be increased transport of combined sewage away from populated areas to the main treatment plant. Flooded basements due to sewage backups will be ameliorated by increased collection capacity from new interceptors, relief sewers, and control facilities.

None of the 82 combined sewer overflow points identified within the study area (Giffels/Black and Veatch, 1977, Book VII) will be eliminated. The quantity of overflows will be reduced somewhat by the improvements to the collection system, however, none of the control measures will be completed by 1981.

Any reductions in CSO along the Detroit River from the DRI-Relief will have a minimal impact on the river water quantity because flows discharged from the DWWTP will correspondingly increase.

The impacts of increased surface runoff from urbanization will occur in the suburbs with or without implementation of the recommended plan. Population increases are predicted for the suburbs regardless of the recommended plan. A further explanation of land use changes in the study area is discussed in Section 7.1.8 Land Use and Developmental Trends.

#### 7.1.4.2 Surface Water Quality

Primary short-term, adverse impacts are anticipated but should be localized and not severe. During the construction phase, 1977 to 1981, water quality degradation may occur locally due to suspended and dissolved material that has washed into sewers from construction areas and subsequently overflowed. Turbidity will increase when soil particles wash into streams. Deposition of sediment will occur in the less turbulent waters of the study area. Adverse consequences of increased sedimentation include the deposition of channel bars, obstruction of flow and increased flooding, alteration of channel configuration, and destruction of aquatic biota through disruption of benthic habitats. The nutrients contained in sediment may stimulate algal and macrophyte growth. The extent of these adverse impacts will not be widespread because the majority of silt-laden runoff flows into sewers or streams with stabilized channels.

The DWWTP will be in compliance with its effluent limits by December 31, 1981, as outlined in the Consent Judgment (Appendix 11.9). Compliance with these effluent limits will have a slight primary long-term, beneficial impact upon the

Detroit River and its downstream receiving waters. Final effluent limitations will be met in four stages providing a realistic pollution abatement program for the City of Detroit. One result of these staged deadlines is that improvements in the Detroit River's water quality will occur slowly.

Water quality modeling (Giffels/Black and Veatch, 1977, Book VI) indicates that concentrations of most substances will increase by the year 2000 despite improved effluent quality from the main plant. This is mainly attributed to increases in non-point source pollution from changes in land use. Growth, development, and their corresponding water quality degradation are expected in the study area regardless of the improvements to the DWWTP. Limits on growth in the suburbs are not a function of DWSD. Sufficient developable land is available within the service area to support the forecasted growth without DWSD sewerage service. The magnitude of the adverse impacts of land use changes will be greater than that of the beneficial primary impacts of the proposed action on an area-wide basis.

River Rouge water quality will not improve because of surface runoff and CSO. No existing CSO points will be eliminated. The quantity of overflows per year will be the same as at present since plans for construction of the West Arm and its associated overflow control measures will be a part of a final facilities plan. Continued urbanization and land use changes will increase the pollutant loads in surface runoff.

Clinton River water quality is not expected to improve because the proposed plan will have minimal emphasis on the Clinton River basin. Suburban interceptors will collect sewage north of the Clinton River and transport it to the DWWTP through the Detroit River Interceptor (DRI and the NI-EA).

Total loading of nutrients, such as phosphorus, and toxic materials, such as phenol, from the DWWTP to the Detroit River will decrease. By 1982 daily loadings of phosphorus will be reduced from 27,783 lb/day (12,600 kg/day)to 5007 lb/day (2271 kg/day) for a flow of 1050 mgd and a discharge concentration of 1 mg P/l. As the largest point source contributor of phosphorus to the Detroit River and the western basin of Lake Erie, the impact of reduced phosphorus loading from the DWWTP should be beneficial to those waters over the long-term. Based on water quality modeling (Giffels/Black and Veatch, 1977, Book VI), phosphorus concentration at all monitored points in the river will decrease, however the concentration at the mouth of the Detroit River (Mile Point 3.9) will still not be in compliance with the recommended phosphorus limitations.

The western basin of Lake Erie should receive primary long-term beneficial impacts from reduced phosphorus loading.

It should be realized, however, that nutrient concentration rather than nutrient supply will control the standing crop of phytoplankton (and macrophytes) in a lake, and therefore the eutrophication process (Dillon, in press). Since nutrient concentration is a function of nutrient loading, lower loading of total phosphorus to the western basin should be reflected in a somewhat lower concentration. Estimates of the response time of Lake Erie to phosphorus control programs indicate that a delayed response can be expected. Phosphorus effluent reductions from the DWWTP by 1982 will probably not affect algal biomass until 3 to 5 years later (IJC, 1975).

Modeling studies by the Army Corps of Engineers indicate that phosphorus concentrations in the western basin must be reduced from 0.037 mg P/l to 0.020 mg P/l to reach a mesotrophic state. Since 40 percent (40%) of the present loadings are from diffuse sources such as surface runoff, point source reduction alone will not be sufficient to achieve the 0.020 mg P/l level (IJC, 1976).

### 7.1.4.3 Groundwater Quantity and Quality

No major primary impacts to groundwater are foreseen. It is possible that some tunneled sewers will reach groundwater tables and create a potential adverse impact.

Some adverse impacts to groundwater resources will occur from increased urbanization but are not directly attributable to the proposed project. Groundwater recharge areas primarily outcrop areas of glacial drift aquifers, will be reduced as more land surfaces in the outlying portions of the study area become paved or covered with buildings. This impact will not be locally severe since groundwater, presently does and will continue to only supply a small fraction of the municipal water demand in the future. Anyone can purchase DWSD water.

Streams which derive a portion of their flow from groundwater may have lowered flows if groundwater tables are lowered. Corresponding increases in surface runoff, however, may offset this impact so that stream flow will not noticeably change.

## 7.1.5 Biota

### 7.1.5.1 Terrestrial

Impacts to terrestrial flora and fauna should be negligible. Most sewers will be tunneled in urbanized areas and the DWWTP construction and pumping station expansions will be contained within existing DWSD property.

Impacts to vegetation and urban wildlife from construction activities at the 26 one-acre access sites and the CSO control structure site are potentially disruptive, depending upon the locations chosen. Plant and animal habitats at the spoil disposal site(s) will be affected by changes in soil structure and topography. Urban plant and animal species are characteristically able to cope with such disruption and will recolonize an area if it provides suitable food, shelter, or breeding area.

### 7.1.5.2 Aquatic

Any change in aquatic habitats that will encourage more pollution-intolerant species must result from significant improvements in water quality in the study area. Based on predictions of future water quality, no such improvement in aquatic habitats is anticipated (Giffels/Black and Veatch, 1977, Book VI).

The overall emphasis of the water quality related impacts is on less degradation rather than on improvement of existing conditions. There will be less degradation to benthic habitats in the Detroit River when BOD and SS loadings are eventually lowered to meet the discharge criteria.

Fish species diversity in the Detroit River will not significantly improve or degrade as a result of the recommended plan. Good upstream water and vast assimilative capacity will remain assets of the Detroit River and the aquatic life it supports. Predictions about fish species diversity and abundance are difficult because of the numerous interactions that determine population dynamics. Existing populations of pollution-sensitive walleyes or the introduced chinook salmon and steelhead trout will be good indicators of habitat quality.

Until CSO are significantly lowered, the long term adverse impact of high BOD loadings will continue to reduce dissolved oxygen levels and stress aquatic life in the River Rouge. Impacts to aquatic biota in the Clinton River will be minor because very few of the collection improvements are being constructed within that watershed. Aquatic biota of that watershed will be most affected by water quality degradation due to increased urbanization (Giffels/Black and Veatch, 1977, Book VI). Despite improvements to and optimum operation of the DWWTP and the collection system, point and non-point source pollution from industrial discharges and runoff will continue to adversely affect aquatic habitats.

The long-term consequences of reduced BOD, SS, and phosphorus loadings from DWWTP will eventually be realized in the western basin of Lake Erie. Algae and macrophytes (large water plants) should gradually respond to lower nutrient inputs with slower growth rates and less biomass. Improved oxygen levels at the sediment surface will encourage oxygen tolerant benthic species to become more numerous. The degree of lake recovery that can be attributed to the DWWTP effluent upgrading is speculative.

### 7.1.5.3 Rare and Endangered Species

Thirty-five terrestrial fauna and seventy aquatic fauna species are listed in Appendix 11.2 as rare, threatened, or endangered in the study area or receiving waters. The recommended plan is not expected to adversely impact any habitats currently used by these species. Collection and treatment improvements are in urbanized areas and it is highly unlikely that sensitive habitats exist within the service area. Changes in water quality resulting from the recommended plan will probably not be great enough to encourage the introduction or proliferation of sensitive, pollution tolerant species.

### 7.1.6 Air Quality

The recommended collection and treatment plan would have little if any effect upon the region's air quality. All impacts relating to incineration and air quality at the DWWTP will be discussed in Section 7.2.7 Air Quality. Localized impacts, however, may occur.

Optimum operation of the main treatment plant will reduce undesirable odors from septic material. Unpleasant odors along overflow points will continue until CSO control measures are implemented.

A primary adverse impact will be increased particulates, hydrocarbons and carbon dioxide loadings from construction activities. The most concentrated area of this impact upon air quality will be at the DWWTP.

Rerouting of traffic during sewer construction may result in traffic congestion with local, temporary degradation of air quality. All of these impacts are insignificant when compared to the overall impact of an urban area such as Detroit upon the region's air quality. Automotive, industrial, and other sources of poor air quality will continue to have an adverse impact upon the region.

### 7.1.7 Aesthetics

Implementation of the recommended plan would have impacts to a very small portion of the DWSD service area. The local impacts are a result of construction and will be short-term. Construction related impacts that will be aesthetically unpleasant, and affect housing quality as well, are dust, noise, traffic disruption, and vibrations from tunneled sewer construction. St. John Cantius Church is a sensitive noise receptor adjacent to the DWWTP. Ambient noise levels around the DWWTP and the surrounding industrial area are usually high and construction has been going on around the church for years. Adverse aesthetic impacts, therefore, will probably be minor.

Proposed interceptor routes have more potential for aesthetic disruptions than the area around the DWWTP. The DRI-Relief has proposed tunnel access sites along Jefferson Avenue which is predominantly commercial and industrial. The access site which will produce the greatest impact from construction is the one near Jennings Memorial Hospital.

Several schools located in Clinton Township may be affected by the Macomb County interceptors:

Clintondale High School;
Clintondale Intermediate School; and
Little Mack Elementary School.

Construction of the Lakeshore Interceptor and Richmond Arm would eliminate the need for the Chesterfield Township sewage lagoons. Residents have complained of noxious odors from these holding basins.

The noise impacts from increasing the pumping capacity at the Connors Creek and Oakwood Pump Stations will be minor. Both pump stations are located in partially industrial areas with few sensitive noise receptors. No major noise impacts are expected from increasing pump capacity at the Bluehill Pumping Station.

The Connors Creek Pump Station is located on Jefferson Avenue, a main thoroughfare. Construction access from Freud Street will minimize traffic disruption. Access to the Oakwood Pump Station from the unpaved road to the east of Liddesdale will minimize disruption to residents on Liddesdale, which is a narrow street.

### 7.1.8 Land Use and Developmental Trends

Implementation of the recommended plan will have little if any regional affect upon land use and developmental trends. The trend of growth and development in the suburbs is anticipated in the future. Land is available for such development but will undergo changes from its present use. Sewerage service to these newly developed areas may be provided by DWSD or some other entity. This rationale forms the basis for believing that few secondary impacts will directly result from this recommended plan.

Localized short-term, adverse impacts will occur at construction sites. Construction of 35,700 lineal feet (10,880 m) of tunneled sewer will require temporary easements to 15 one-acre sites. Residential, institutional, or recreational land uses at these sites or adjacent to these sites may be temporarily disrupted. Tentative access sites along the DRI-Relief indicate land use conflicts with two parks (Memorial Park and Waterworks Park) and Jennings Memorial Hospital along Jefferson Avenue. The suburban interceptor access sites are located near low density residential land and along major highways. Access sites adjacent to highways should create minimal land use conflicts. Land use conflicts arise when normal land uses are disrupted. These conflicts include visual distractions that may result in traffic inconveniences or hazards and odors and noises that are disruptive to normal activities in that area.

The potential exists for changes in land use at these tunnel access sites after construction is finished. Since recreational land is in high demand in Detroit, a potential beneficial impact would be the creation of neighborhood parks at the access sites.

No land acquisition is scheduled for the pumping station expansions; therefore, no land use conflicts are foreseen. Proposed expansions should not affect adjacent land use.

There is a potential land use conflict at the site of the one pilot study CSO control structure. Site locations for the CSO control structures discussed in earlier alternatives (Giffels/Black and Veatch, 1977, Book XIV) were primarily existing recreational land.

Secondary impacts of growth and development will be minimal since most collection improvements will occur in highly urbanized areas. The proposed suburban interceptors into Macomb County may stimulate limited local urban development.

### 7.1.9 Population and Demographics

The land acquisition necessary for the 15 one-acre access sites along the tunneled DRI-R and suburban sewers may involve relocations of households. It is not known how many access sites are currently available without relocation.

Construction from 1977 to 1981 at the existing DWWTP site may encourage residents in the adjacent DelRay neighborhood to relocate. It is more probable, however, that residents will wait for housing reimbursement if their neighborhood is selected for the DWWTP expansion site.

### 7.1.10 Cultural Resources

#### 7.1.10.1 Recreational

Since no major changes in water quality or river habitats are anticipated, any beneficial impact from localized river impoundments will be minor.

Two tunnel access sites for the DRI-R are near recreational areas, Waterworks Park and Memorial Park. Up to one acre of each of these parks may be temporarily, but adversely, impacted by construction activities while the sewer is tunneled.

#### 7.1.10.2 Cultural

No known cultural areas will be impacted.

#### 7.1.10.3 Archaeological and Historical Sites

The proposed route of the DRI-R will pass two sites listed in the National Register of Historic Places. They are the Hurlbut Memorial Gate and the Pewabic Pottery Building (Giffels/Black and Veatch, 1977, Book IV). Neither of these locations is a tunnel access site but some assessment of the exact tunneling route, structural strength of each historic site and the amount of vibration from tunneling activities would need to be made prior to construction.

No known archaeological sites exist in any area of proposed construction. Any construction involving excavation may lead to the discovery of such sites. Since these sites could increase knowledge of the archaeological history of the area, construction would be halted until an evaluation of the discovery is made.

### 7.1.11 Socioeconomics

#### 7.1.11.1 Economics

A construction project of the magnitude and duration of the recommended plan will have a beneficial effect on the construction industry. The peak year expenditures (year 1979) will be 239.5 million to construction or approximately ten percent of the region's income during that year. If a multiplier of 2.5 is assumed this will account for $598.75 million in the regional economy. Further, if 30% of the construction costs are assumed to be labor dollars with an average wage of $15,000/year, then the proposed action will produce approximately 4,790 jobs/year during the peak year. Although less than one percent of region's employment, it could account for a 1.1% reduction in unemployment. Assuming the 2.5 multiplier for employment then the effect is a 2.6% reduction in the 1976 rate of unemployment (U.S. Department of Labor, 1977).

### 7.1.11.2 Employment

The SFP recommends staffing levels of 476 fully trained and qualified employees with many maintenance services contracted to private companies. DWSD, realizing that such a theoretical work force cannot be achieved and wishing to reduce the amount of contracted maintenance, has projected an employment of 1,000. It is likely that the actual operation and maintenance staff level will fall somewhere between the two figures.

Competent workers are necessary for the optimum operation and maintenance of the existing DWWTP facilities. A concerted effort should be made to achieve the SFP recommended staffing level. A difference of 500 additional staff, which may be less than qualified, would make a significant difference in the amount of money budgeted for salaries. For purposes of illustration, 500 jobs at an average salary of $15,000/year would add an extra $7.5 million/year to operating costs and $150 million over the next 20 years.

The federally mandated user charge/industrial cost recovery system will increase costs to residential, commercial, and industrial customers. Since the costs to the users will remain below the national averages, such increases are not expected to affect industrial location. In addition, adequate wastewater collection and treatment will be provided so there will be little or no influence on investments in the region.

### 7.1.11.3 Sociology

An adverse impact of sociological significance is the effect of construction at the DWWTP upon the adjacent ethnic Hungarian neighborhood of DelRay which includes St. John Cantius Church. Construction has been going on around this neighborhood for years and the severity of impacts from the 1977-1981 first category construction should be no worse than at present. A special DelRay neighborhood analysis will be one of the subjects of the final facilities plan.

### 7.1.12 Energy

Increase consumption of gasoline and diesel fuels will result from the short-term but intensive use of heavy machinery and other equipment during construction. Use of electrical power will increase during tunnel construction activities, but these impacts will be short-term and not significant on a regional basis.

A primary long-term beneficial impact to energy use may come from more efficient operation of the DWWTP incinerators.

Upgraded incinerators may be capable of autogenous burning and thereby consume less fuel during their operation than at present. Further discussion is found in Section 7.2.13 Energy.

Present energy consumption, including electricity, natural gas, and diesel fuel, is approximately $2.6x10^{12}$ BTU/year. Energy consumption will increase as a result of this project. Estimated energy demands are equivalent to $5.09x10^{12}$ BTU/year or $35.35x10^{6}$ gallons of #2 diesel fuel. More electrical power will be needed for the optimum operation and maintenance of the existing facilities and the expanded pump stations. Energy increases are also attributed to the Unox activated sludge process which utilizes pure oxygen. Energy is needed to separate oxygen from the air and also to mix the pure oxygen with sludge.

Energy impacts should not be significant when compared to power consumption increases in the study area as a whole in the next 20 years.

### 7.1.13 Public Health

The recommended plan will have localized beneficial impacts to public health. One of the objectives of the proposed collection system is to reduce flooding in basements. Elimination of the nuisance flooding will protect residents from contracting enteric diseases through direct contact with any combined sewage.

Continued poor surface water quality in the area's rivers, particularly high fecal coliform levels after storm events, will remain a public health hazard for any recreational uses of the rivers. Exceedingly high fecal coliform counts have been predicted for all three rivers. The main sources of these bacteria for the River Rouge and the Detroit River will be CSO and surface runoff, and in the Clinton River, surface runoff. Further studies on CSO will be addressed in the final facilities plan.

Potential safety hazards exist to motorists and pedestrians, particularly children, from construction activities at access sites. As previously noted, some tunnel access sites are located near schools, a hospital, and public parks.

### 7.1.14 Public Facilities

Traffic disruptions from sewer construction during the years of first category construction (1977-1981) may adversely affect public facilities and services, such as garbage collection. Emergency services response time may be increased by the collection system construction. These temporary disturbances will be localized around access sites and not significant to the study area as a whole.

## 7.2 Residuals Processing and Disposal Impacts

### 7.2.1 Introduction

The recommended plan designates specific operational and structural improvements to the existing sludge processin facilitities at the DWWTP. Landfilling is recommended as the disposal technique for the incinerator ash and scum/grit by-products of the DWWTP process. At this stage of the planning process detailed plans have not been formulated for the operation of this landfill.

The environmental impacts of a landfill operation are potentially significant, therefore impacts have been analyzed for an example site based on several assumptions as to the type of landfill operation. These impacts should provide guidance to the grantee in developing his future landfill operations.

For the purpose of this analysis, an example landfill site was located 45 miles north of Detroit within a 4 section area in Brandon and Oxford Townships, Oakland County. This site was chosen because it is typical of the natural environment of the area, beyond urban centers, readily available at reasonable costs ($1,200/acre as shown in Oakland County Tax Records) and has access to a major highway.

Major assumptions for this analysis are based on proper landfill design and operation. These assumptions include daily covering of the ash and a thicker covering of the final composite, use of an impermeable liner to protect groundwater, and ultimate plans for an aesthetic use of the land after completion of the project.

A detailed landfill site analysis will be prepared during the final facilities plan on areas within and outside the study area.

### 7.2.2 Climate

Although the recommended incineration-landfill plan will not significantly change the overall climate of the study area, certain minimal impacts will occur.

The structural improvements designated for the incineration process, will supply a beneficial impact to the climate of the area. The effects of air pollution on climate are well documented. Emissions of particulates supply an unnatural abundance of nucleus around which moisture collects and condenses, falling as rain or snow. By reducing the particulate emissions from the incinerators, downwind precipitation patterns will achieve a minimal degree of normalcy.

The structural components dictated in the recommended plan will minimally add to the current "heat island" condition occurring in the Detroit area. Due to the amount of construction anticipated, this impact will be insignificant.

### 7.2.3 Topography

The example landfill site in Oakland County is located within a "rough morainic belt characterized by ridge-like hilly deposits interspersed with nearly level or gently rolling till plains or ground moraine, and generally broad, flat, sand and gravel outwash features pitted with water-retaining depressions" (Giffels/Black and Veatch, Book II, 1977). The particular topography of the example site includes slopes ranging from 7 to 18% (USDA, 1975) as well as interspersed water-retaining depressions. The elevation of the example site ranges from 1050 feet in the basins to 1170 at the areas highest point.

The proposed residuals disposal plan will have a primary adverse impact of permanent duration on the landfill site. Due to the nature of the excavation and refill process, the current topographical features of the landfill site will change. It is difficult to predict the exact nature of change at this stage of the planning process, but its significance is expected to be minimal. By implementing the proper landfill techniques, the topography can be nearly restored to its original condition.

The consequences of the topographic change are twofold. The first is that topographical changes will influence surface water quantity, and the second is that localized drainage problems may create nuisance conditions hindering the landfill operations. During the operation of the landfill, a working area (i.e., an area capable of containing 4 days of refuse) will constantly remain disturbed. Stormwater ponding and erosion in the work areas is likely to occur. Although this will have no significance to the overall area, it may create conditions which make proper operation difficult.

Construction of the structural components designated in the recommended incineration plan will not affect the topography of the DWWTP site.

### 7.2.4 Soils

The soils at the example landfill site can be generally described as well drained, coarse to moderately coarse texture, and underlain by sand and gravel (USDA, 1975). These soils tend to be developed to a shallow depth, low on organic matter and nutrients, and have a well defined structure.

The soil structure and its characteristic properties will be permanently changed as a result of the landfilling process. In its place will be a layering of incinerator ash and soil with a thick cover layer of homogeneous topsoil. In an area which now experiences moderate to poor agricultural production, rapid permeability, and lack of a well defined soil structure, these impacts will be minimal.

A primary adverse impact of the landfill process is soil loss by erosion. For the duration of the landfill operations (20 years) exposed areas at the site will be more susceptible than vegetated areas to wind and water forces carrying away soil. This impact is minimized by restricting the exposed areas of the site to that needed for 4 days of landfilling (an operational requirement established before licensing).

### 7.2.5 Hydrology

#### 7.2.5.1 Surface Waters

The proposed project will influence the surface waters of the study area. Minimal primary impacts affecting both the quantity and the quality of the waters are expected as well as minimal secondary impacts. These impacts are generally limited to the landfill site and immediately adjacent areas.

Contamination of surface waters with incinerator ash is a primary adverse impact which may occur during the life of the landfill. Incinerator ash contains less than 10% of the nitrogen content of sludge, along with heavy metal oxides and salts (Giffels/Black and Veatch, 1977, Book XII). Runoff containing this material will degrade surface water quality.

Surface water contaminants can result from incinerator emissions, ash lost in transport to and operation of the landfill, and runoff or leaching from the landfill site. Fly ash discharge from incinerator operation is expected to be minimal because of the required air pollution control devices. Ash in its dry state is very difficult to handle. As a result, substantial losses may occur during transport and landfilling. Proper landfill process design, which includes handling and disposal of the ash in a water slurry form (Pavoni et al., 1975), will reduce loss to an insignificant amount. Compacted refuse layers are covered daily with a layer of soil and a final thicker layer of soil covering the completed composite (Pavoni, et al., 1975).

Soil erosion damage may result from construction activities at the landfill site, the DWWTP, and secondary development areas. Eroded soil particles may ultimately be deposited in streams and degrade water quality.

#### 7.2.5.2 Groundwater

Groundwater is not substantially utilized in the region, however, it is important as a local drinking water source and as a source of surface water flows. At the example site, bedrock and glacial drift are both sources of groundwater. The quality of this water ranges from generally good to poor (see Section 2.5 Hydrology).

Groundwater levels at the example site, seasonally rise to as high as 3 feet below the surface (USDA, 1975). Therefore the potential for stormwater leachate percolating through the landfill and into groundwater reservoirs is high. In order to protect the groundwater quality, the recommended landfill will be lined with an impermeable material and fitted with a drainage system.

Implementation of the recommended incineration plan will not affect the groundwater situation in the study area.

### 7.2.6 Biota

#### 7.2.6.1 Terrestrial Biota

Operation of the landfill at the selected site will result in a temporary loss of vegetation and the wildlife it supports. Current vegetation and wildlife of the area are typical of cropland undergoing succession to forest. The most significant long-term impact that will occur is the loss of few large, old trees.

Operation of the landfill will result in forcing existing wildlife populations to find suitable new habitat. While similar habitat exists nearby, displaced individuals will be forced to compete for the existing food supply and cover. As a result of the increased competition for food and cover, populations of wildlife may decrease in the immediate area. The expected decrease will not be significant on a region-wide basis.

Construction of new sludge processing facilities at the DWWTP will have a permanent but insignificant impact because the existing plant site contains little, if any, suitable habitat for animals.

#### 7.2.6.2 Aquatic Biota

As with surface water quality, the aquatic biota will be only minimally affected by construction or operation of the landfill.

A primary adverse impact to stream habitats within the landfill site may be increased turbidity and siltation from soil erosion. Soil particles in the water may reduce light and inhibit photosynthesis, cover spawning areas, and cause respiratory difficulties in fish and invertebrates. This impact should be minimal.

Incinerator ash loadings may act to fertilize aquatic habitats with nutrients such as nitrogen and phosphorus that stimulate plant growth. This impact should be minimal because available nutrients are very limited in the ash (Giffels/Black and Veatch, 1977, Book XII) and proper landfill construction and operation will prevent most contamination.

### 7.2.6.3 Rare and Endangered Species

The facilities planning consultants note that 35 terrestrial fauna species and 70 aquatic fauna species have been designated as endangered, threatened, or rare within the general study area (Appendix 11.2). Although no search was made of the example landfill for these species, the proposed site may contain suitable habitat within its varied topography. Before such a landfill operation can be licensed though, a complete survey of the site must be done.

### 7.2.7 Air Quality

Implementation of the recommended plan will provide the structural controls necessary to substantially reduce air pollution from the existing incinerators. As a result, the localized ambient air quality will be significantly improved , but the overall study area air quality will not be noticeably affected. Landfill operations will minimally affect localized air quality. During the 3 year period of incinerator optimization (timetable for recommended plan implementation) certain impacts which are unique only to this period of operation will occur.

These short-term impacts are primarily due to construction activities. Particulates from wind blown dust and construction vehicle exhaust will contribute minimally to air pollution. Odor and noise increases from diesel powered equipment at DWWTP and at the landfill. These impacts will be limited to daylight working hours. Also during the 3 year optimization program, the incinerator of Complex I will continue to function. Emissions from these sources will continue at their present rates, violating county and state regulations and creating a less than desireable ambient air quality situation. By mid-1979, the ambient air quality will begin to show signs of improving as the first of the incinerators is completed with structural improvements. By mid-1981 all six incinerators of Complex I will meet standards and the ambient air will show corresponding changes in quality.

The long-term air quality impacts of the recommended plan are primarily beneficial. The most significant of these is that once proper controls are installed (mid-1981), emission standards will be met. This will be a significant improvement over the existing conditions despite the anticipated rise in sludge loadings. It is important to note that despite the improvement in incinerator emissions, the overall ambient air quality of the Detroit area will be relatively unchanged. Violations of ambient air quality standards will continue due primarily to the high background level of pollutants caused by numerous air pollution sources throughout the city.

A second long-term effect will be fugitive dust from ash transportation and landfill operation. This will contribute to particulate loadings. These emissions will be widely dispersed and if proper measures are taken, they will be insignificant. By transporting ash as a water slurry in covered trucks, and prompt revegetation of exposed areas at the landfill site will largely mitigate these emissions.

Another long-term effect is that odors from the incinerators will be largely eliminated. Zero hearth afterburners which are being installed in the incinerators will reduce particulate emissions and especially control emissions of undestroyed putresible material.

### 7.2.8 Aesthetics

Major impacts to aesthetics will result from landfill operations, transportation of ash to the disposal site, construction activities at the DWWTP, and future secondary development around the landfill site. Fugitive dust, litter, and degraded roads and landscape unless controlled, will create a significant adverse impact for local residents.

Earth moving will be a visual detraction at the site for the duration of the project. Noise from trucks and earth moving equipment will produce a minimal, localized impact. This impact will affect only the residents of the immediate area only during working hours. Aesthetic impact will be highly localized and therefore insignificant to the overall study area.

### 7.2.9 Land Use and Developmental Trends

The landfill operation would significantly affect only the existing residents on the site. There are approximately 85 residential homes located within the example site (U.S. Department of Interior, 1968). These homes are primarily well-kept, mid-priced residences and farms. Implementation of the recommended plan would require that these residences be moved, and is likely to meet with strong opposition.

The area itself does not lie within the short-termed urban expansion plans of either Detroit or Oxford. The locations may be included on the extreme outer edge of the Detroit urban sprawl.

A landfill at this example site will not greatly jeopardize the future suitability of the land for other use. The area is classified primarily as IIIe and VIs by the USDA (USDA, 1975). Classification IIIe indicates that the soils have severe erosion limitations that reduce the range of plants grown and their productivity and require special conservation practices. Because of soil shallowness the soils are generally unsuited to cultivation and limited in their use to pasture, range, woodland, or wildlife habitat VIs. This situation is evident from visual inspection of the area. The land was once cleared for cultivation but has since been either abandoned or used for pasture. Today the bulk of the example site is in various stages of succession and is considered open space and pastureland. Further limitations to existing land use of the area are presented in Table 7.2-A.

Implementation of this project will have no significant primary impacts on land use in the area except to the residents now living at the landfill site. Future secondary development is possible, depending on the ultimate use of the landfill, thus changing some land use from open space to residential.

### 7.2.10 Population and Demographics

Private residences within the boundaries of the landfill and buffer zones are prohibited. This restriction will impact a relatively small number of people (see Section 7.2.9 Land Use). The aesthetic detriments created by the landfill will affect a number of people adjacent to the site. Depending on the ultimate use of the landfill site, an aesthetically pleasing development could eventually attract residents.

### 7.2.11 Archaeological and Historical Sites

No archaeological or historical sites are known to exist in the example landfill. Excavation of the landfill may lead to the discovery of archaeologically important information on the area. Construction would be halted until an evaluation of the discovery was made.

### 7.2.12 Socioeconomics

The landfill site will require acquisition of the land prior to commencing operations. The land at the example site is privately owned and assumed taxable. The taxes from the sale will be offset by the loss of real estate or property taxes for the planning period to local units of government.

## TABLE 7.2-A

## LIMITATIONS FOR USE

| | |
|---|---|
| Agriculture | Moderate to Severe |
| Forestry | Moderate |
| Home Sites | Moderate |
| Septic Tanks | Moderate |
| Park and Play Areas | Moderate |
| Camp Areas | Moderate |
| Open Land Wildlife | Moderate |
| Wood Land Wildlife | Moderate |
| Wetland Wildlife | Severe |

The costs of acquiring the site and transporting the ash to the landfill are less than other alternatives. Owners of the acquired property would be justly recompensed for their property.

The residuals disposal (ash) will create some new jobs, mostly at the DWWTP, although personnel will be required at the landfill. Most jobs will be skilled to semi skilled operators and laborers. Section 7.1.11 presents the economic impacts of the recommended plan including the residuals disposal requirements.

### 7.2.13 Energy

Proper implementation, operation, and maintenance of the recommended sludge processing plan will require an estimated $33.2 \times 10^{10}$ BTU/year by 1980 and $41.6 \times 10^{10}$ BTU/year by 2000 of energy. These figures include electrical energy for the vacuum filters and incinerators, auxiliary fuel for the incinerators (start up) and diesel fuel required to haul ash to the landfill. By upgrading the existing incinerators, autogeneous burning may be possible. The significance of reaching this condition is that a substantial savings in auxiliary energy will be realized (over current situation). Only during operation start up will auxiliary fuel be necessary.

Despite the anticipated increase in sludge volumes, the number of truckloads of incinerator ash being hauled may go down or stay relatively the same. Due to better operation techniques, structural improvements and improved reduction efficiencies, ash loads should not increase.

The energy requirements for landfill operations are anticipated to be 250,00 gallon #2 fuel oil per year, reflecting the earthmoving vehicle needs. Currently DWSD does not operate residuals disposal facilities, therefore this impact is adversed and long-term.

### 7.2.14 Public Health

The incineration process completely eliminates pathogenic organisms from the sludge The result is a sterile ash residue which is relatively safe for human contact. The landfilling process will have no significant impact on the public health of local residents.

Minimal impact may be experienced from fugitive dust from construction sites and the landfill operations. This situation may produce temporary eye and respiratory irritations to nearby residents.

## 7.3 Institutional

Since the same institutional arrangement will continue, the major impact remains a financial one. Suburban jurisdictions have in the past resisted any rate increases and can be expected to resist future increases. Failure to provide sufficient monies for the local share would place construction grants related to this plan and future plans in jeopardy.

## 7.4 Summary

This chapter describes treatment and collection, residuals processing and disposal, and institutional impacts of the selected plan. These impacts are evaluated as to their duration and intensity. This chapter forms the basis for the mitigating measures in Chapter 8.0.

# 8.0 LONG TERM VERSUS SHORT TERM CONSIDERATIONS

The following chapter presents the mitigating measures necessary to minimize the environmental impacts of the recommended plan as presented in Chapter 7. The primary and secondary impacts of the recommended plan are summarized. Commitments of resources required in the plan, both primary and secondary, are presented. The long-term impacts versus the short-term impacts are assessed.

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# 8.0 LONG TERM vs. SHORT TERM CONSIDERATIONS

## 8.1 Mitigating Measures

The adverse impacts of the recommended plan and their severity have been discussed in Chapter 7.0. The severity of many of these impacts can be reduced by implementing mitigating measures. The mitigating measures needed for the recommended plan are divided into two main areas; collection and treatment and residuals processing and disposal.

### 8.1.1 Collection and Treatment

Construction, operation and maintenance of the DWSD collection and treatment system requires mitigating measures to minimize the unavoidable adverse impacts. The mitigating measures necessary, may be grouped into two broad groups - those necessary for construction related activities and those relating to the continuous operation and maintenance of the DWSD system.

The mitigating measures required for construction are intended to minimize the adverse effects to the environment while allowing construction of needed facilities. Construction related measures include good construction practices, restoration of disturbed areas, and proper spoil disposal plans. Other construction practices include dust control, noise attenuation where possible and practical, erosion and sedimentation controls, traffic control, and reducing attractive nuisances. Attractive nuisances such as open trenches construction, equipment storage sites, and above ground structures should have restricted access. Restricted access would reduce the safety hazards to construction workers and the public. Dust control could include covering trucks as needed, keeping streets free from spoil, and spot control of dust at construction sites as needed.

Noise reduction measures should include proper maintenance and operation of equipment to minimize noise. Routing of trucks and other heavy equipment along main arterial streets as much as possible would reduce noise.

Erosion and sedimentation control should comply with the Michigan Erosion and Sedimentation Control Act of 1972 (Act 347). Erosion and sedimentation controls would include barriers to stop runoff, revegetation and reducing length of time soil is exposed.

Efficient routing of trucks and heavy construction equipment through main arterial roads would reduce safety hazards and noise in residential areas. Emergency service organizations should be kept notified of restricted access areas or streets blocked off by construction to ensure prompt delivery of their services to residents.

Restoration of disturbed areas would reduce impacts by hastening the return of disturbed areas to their previous condition or a more desirable state. Sidewalks, streets and lawns should be promptly restored to their original state. Open space, woodlands, and other forested areas should be revegetated with native vegetation where disturbed. Disturbed areas may be converted to recreational space in areas where the site is located in an area with little recreational space.

Planning for spoil disposal would assure construction spoils are placed in a properly selected location and in the proper manner. The disposal site should be properly selected to minimize the adverse affects of the spoil accumulation. Beneficial uses of spoils such as fill for construction, cover for landfills, etc. should be sought.

The proper operation and maintenance of the DWSD wastewater system should reduce the health risks, odor problems and improve water quality insofar as possible. Odors should be reduced by improvements to the treatment processes at the plant and modifications to the sludge incinerators. Improvements in maintenance and operation of the collection and treatment systems should enhance overall water quality in the area by improving the DWWTP's effluent quality.

### 8.1.2 Residuals Processing and Disposal

Mitigating measures are necessary to reduce the impacts of residuals processing and disposal systems. The mitigating measures necessary include selection of the landfill site, proper design and planning of the landfill, and relocation of displaced residents.

Selection of the landfill site will require analysis of all natural and human environment factors at potential sites. Evaluation of the existing situation will determine present geology, topography, hydrology, terrestrial flora and fauna, archaeological and historical resources, land use, socioeconomic conditions. Comparison of the potential sites will allow selection of a site(s) which have the lowest overall impact and is without any serious impacts in any one area.

Proper design and planning of the landfill would allow the impacts of the landfill to be reduced by incorporating mitigating measures into the design. Proper design and planning should include erosion and sedimentation control, buffer zones, relocation assistance, site restoration and proper operation and maintenance.

Erosion and sedimentation control should comply with the intent and requirements of the Michigan Sedimentation Act (Act 347 of 1972). Erosion and sedimentation control would reduce and/or eliminate soil loss from erosion, topography change due to erosion and/or sedimentation, and aquatic habitat damage from sedimentation. Erosion and sedimentation control could consist of [illegible] measures as site grading to reduce runoff, revegetation of distrubed areas, runoff barriers st the margins of distrubed areas, and timing large earth moving activities during periods of low erosion hazard.

Buffer zones would protect surface water bodies from direct impacts of the landfill, create visual amenities, and if designed along public access, create a visual screen for the landfill.

Relocation assistance for any displace residents is required by Federal Law. Assistance is in the form of financial help to find habitation and employment if required. Adequate notification of relocation and just, fair compensation for displaced persons is also required.

Site restoration of distrubed areas would reduce erosion, both wind and water caused, and provide aesthetic improvement. Restoration could include grading to create visually conforming landforms, planting of native vegetation including shrubs, trees and grasses and placing topsoil as the final covering over the landfill.

Proper operation and maintenance of the landfill would reduce impacts by controlling dust, covering the ash promptly, and reducing public health risks, and minimizing area disturbed at any one time.

Daily covering of the ash would minimize the potential of public health risks due to exposed ash. The potential for erosion and transport of the ash would be similarly reduced. The last or final layer of ash in any compartment would receive a significantly thicker soil covering. This top layer of soil would then be a substantial medium for planted and native vegetation to grow.

An impermeable liner would be installed to protect groundwater. The impermeable liner would prevent leachate from the landfill percolating into the groundwater. If necessary the leachate could be collected and treated prior to discharge.

Restoration of the landfill site(s) after completion of operations could create an open space resource for the region. Final site restoration could include planting trees, grading irregularities to create visual differences, and recreational use plans. Ultimate use of landfill sites could be parks, golf courses, passive recreations, etc.

## 8.2 Unavoidable Adverse Impacts

The recommended plan of improvements and modifications to the DWSD wastewater system will cause minimal adverse impacts to the Detroit metropolitan area. Few of the primary impacts can be avoided, however, the mitigating measures described in Section 8.1 will reduce the severity of the impacts. The impacts of the recommended plan and their severity have been described in Chapter 7.0. The following discussion summarizes the primary and secondary impacts from collection and treatment and residuals processing and disposal. For convenience, the collection and treatment impacts are separated from the residuals processing and disposal impacts.

### 8.2.1 Collection and Treatment

#### 8.2.1.1 Primary Impacts

Adverse impacts resulting from the recommended treatment and collection plan are primarily a result of construction. Topography at the tunnel access sites, at the DWWTP, and at the site of the one CSO demonstration control structure will be modified during construction. Soil erosion damage at these sites may also result in sediment deposition in rivers and local streams and subsequent water quality degradation. Suspended sediment in stormwater runoff that flows into sewers will impact the collection system and the wastewater treatment facilities. The spoil from the tunneled sewer excavations will have a major impact on the topography of the selected site (Section 7.1.2).

Destruction of vegetative cover during construction, including grasses, shrubs, and trees, will adversely impact urban wildlife habitats. Construction machinery will cause local air quality degradation from increased particulates, hydrocarbons, carbon dioxide, and also cause compaction of soil. Dust, noise, traffic disruption, and vibrations from tunneled sewer excavation are short-term nuisances from construction. Access sites for the tunnel sewer construction will cause changes in existing land use. Two proposed access sites are recreational land, one access site is near a hospital, and two potential access sites are recreational land. At and adjacent to the access sites construction will be disrupting and disturbing. Temporary inconvenience to transportation and access to facilities and services will result from construction of the recommended collection improvements. Tunneled sewers may, in some areas, reach below the groundwater table. Contamination of groundwater during and after construction from exfiltration may occur.

With few exceptions, the primary adverse impacts from the proposed collection and treatment system will be short-term. If the proposed mitigating measures are not implemented, some short-term impacts may become long-term.

#### 8.2.1.2 Secondary Impacts

The recommended plan will not provide additional sewerage service to the study area. Therefore secondary impacts are not anticipated to be significant. Limited local development may occur with or without the recommended plan improvements and modification.

### 8.2.2 Residuals Processing and Disposals

#### 8.2.2.1 Primary Impacts

The primary impacts of residuals disposal will be long-term and result from project operation rather than project construction. Air quality at the DWWTP will improve slightly. Approximately 260 acres (104 ha) are needed in a relatively undeveloped location for the landfill disposal of incinerator ash. Soil structure at the landfill site will be permanently disrupted and heavy metals, nutrients, and salts will concentrate. Denuded portions of the landfill site will suffer soil erosion and associated aesthetic detriments although restoration and mitigating measures will reduce these impacts. The topography at the site will be changed, modifying runoff patterns. Aesthetics of the area will be changed by operation of the landfill. Land use changes at the landfill site will eliminate existing residences. This impact is significant to the households concerned, although it is an insignificant land use change on a regional or county wide basis. Unknown archaeological artifacts at the landfill site may be uncovered during landfill operations.

#### 8.2.2.2 Secondary Impacts

The completed landfill may be utilized as a recreation area. The recreation use could cause limited service development as a secondary impact. No other secondary impacts have been identified as a result of the recommended plan.

## 8.3 Irreversible and Irretrievable Commitments of Resources

The following discussion summarizes the adverse effects that the proposed project will have on the beneficial use of the environment by permanently committing land, construction materials, and biological, human, and economic resources. These resource commitments have been separated into primary and secondary commitments.

### 8.3.1 Primary Resource Commitments

Land necessary for the landfill site cannot be used for other purposes during the life of the project. Rights-of-way which are not located along highways will restrict land use activities across them to agricultural, recreational or open space.

Labor will be irreversibly committed to the construction and operation of the system. A partial list of materials and natural resources required include rock, concrete, steel, glass, putty, clay, wood, plastic and asbestos compounds. Seeds and plants will be required for landscaping disturbed areas. Operation of the system will require chlorine for effluent disinfection, chemicals, and fossil fuels to generate the electricity required to operate the DWWTP including incineration and disposal of residuals.

### 8.3.2 Secondary Resource Commitments

No discernible commitment of regional resources is anticipated as a result of secondary impacts. Secondary impacts are a result of urbanization, not the recommended plan (by definition, secondary impacts are those related to induced growth). The rate, character and direction of urban development will not be affected by the recommended plan. Extensions of service areas and/or increasing capacity of the treatment plant is not recommended, effectively restricting secondary impacts of the plan.

Changing environmental situations may necessitate flexibility in the recommended plan within the planning period. Flexibility in the operation and maintenance of the collection, treatment, and disposal systems may be needed for the following circumstances:

- Future upgrading of treatment requirements may dictate expanding the treatment plant or abandoning it in favor of a more economical solution. Therefore, proposed facilities may have to be altered significantly during the financing period:
- Accommodation to changes in the availability and cost of fuel as energy demands increase and fossil fuel supplies decrease; and
- The use of land application of sludge or liquid effluent for nutrient recovery if fertilizers become too costly or scarce.

### 8.4 Relationship Between Local Short-Term Use of Man's Environment and the Maintenance and Enhancement of Long-Term Productivity

The recommended plan for the DWSD system will reduce the rate of environmental degradation and provide facilities for the enhancement of long-term growth and productivity of the Detroit Metropolitan area. The costs of the project, the short-term environmental disruption and the long-term commitment of limited resources are believed necessary. The total cost of the plan is less than the cost of the 1975 facilities plan rejected by U.S. EPA.

By optimizing the facilities and correcting current deficiencies, the recommended plan makes maximum use of existing buildings and processes. Adherence to discharge permits and emission standards will minimize the adverse effects of dispersing waste water and residuals to the environment. The sewage treatment facilities will have capacity to treat projected wastewater flows during the planning period. The individual pieces of equipment have a life expectancy equal to or greater than their financing period. Operation and maintenance of the facilities is required but these costs will be supported by annual user charges. Facilities which are not needed during the planning period have not been recommended.

The recommended plan does not foreclose on future options. In fact, the proposed plan requires an investigation of future alternatives for sludge disposal. If, for example, sludge composting becomes feasible in the future, the existing incinerators may be abandoned. The final facilities plan includes a CSO study and a storm water management plan.

## 8.5 Summary

Chapter 8 presents mitigating measures which, if implemented, will ameliorate some adverse impacts of the recommended plan. Unavoidable adverse impacts are summarized according to primary or secondary and short or long-term effects of the plan. Primary and secondary resource commitments are listed. Long-term benefits of the recommended plan are weighed against the short-ter use of man's environment.

## 9.0 AGENCIES, GROUPS, AND INDIVIDUALS NOTIFIED OF THIS ACTION

The following chapter presents these agencies, groups, and individuals notified of this action. Copies of this Environmental Impact Statement were mailed to each of the listed agencies or parties.

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# 9.0 AGENCIES, GROUPS, AND INDIVIDUALS NOTIFIED OF THIS ACTION

## 9.1 Local and Regional Representatives Notified

### 9.1.1 City of Detroit

Mayor Colman A. Young
City Council
City Planning Department
Board of Water Commissioners
Director of Detroit Water and Sewerage Department.

### 9.1.2 City Clerks of the following jurisdictions:

Farmington
Orchard Lake Village
Ferndale
Ogle Park
Keego Harbor
Hazel Park
Northville
Melvindale
Livonia
Plymouth
Wayne
Romulus
River Rouge
Madison Heights
Novi
Troy
Pleasant Ridge
Rochester
Royal Oak
Southfield
Center Line
Clawson
Huntington Woods
Westland
Lathrup Village
Warren
Memphis
East Detroit
Fraser
Sterling Heights
New Baltimore
Richmond
Roseville
Wixon
South Lyon
Sylvan Lake
Walled Lake
Mount Clemans
St. Clair Shores
Grosse Pointe Farms
Grosse Pointe Woods
Dearborn Heights
Grosse Pointe
Garden City
Allen Park
Pontiac
Dearborn
Inkster
Highland Park
Harper Woods

### 9.1.3 Township Clerks of the following jurisdictions:

Clinton
Bruce
Armada
Canton
Grosse Pointe
Avon
Springfield
Southfield
Independence
Redford
Bloomfield
Addison
Richmond
Harrison
Ray
Van Buren
Plymouth
Orion
West Bloomfield
Chesterfield
Royal Oak
Northville
Pontiac
Brandon

Commerce
Lenox
Farmington
White Lake
Macomb
Waterford
Shelby
Novi
Oakland
Washington
Oxford

### 9.1.4 Village Clerks of the following jurisdictions:

Romeo
New Haven
Lake Orion
Holly
Grosse Pointe Shores
Lake Angelus
Oxford
Armada
Franklin
Beverly Hills
Clarkton
Wolverine Lake
Leonard

### 9.1.5 County Clerks of the following jurisdictions:

Wayne County
Oakland County
Macomb County

### 9.1.6 County Agencies:

#### Oakland County

Board of Health
Drain Commissioner
Department of Public Works
Planning Commission

#### Wayne County

Department of Health
Board of Commissioners
Drain Commissioner

#### Macomb County

Health Department
Road Commission
Planning Commission
Drain Commissioner

### 9.1.7 Multi-jurisdictional Agencies

South Macomb Sanitary District
Lake St. Clair Advisory Commission
Huron-Clinton Metro Authority
Southeastern Michigan Transportation Authority
Great Lakes Basin Commission
Inter-County Highway Department of Southeast Michigan
Southeast Michigan Council of Governments
Ohio River Basin Commission
Upper Mississippi River Basin Commission

## 9.2 State Representatives Notified

The Clerk, State Senate
Conservation Committee, State Senate
The Clerk, House of Representatives
Conservation Committee, House of Representatives
Bureau of Management and Budget
Department of State Highways
Department of Natural Resources
Attorney General
Department of Public Health
Department of Agriculture
Bureau of Outdoor Recreation

## 9.3 Federal Representatives Notified

Hon. Robert Griffin, U.S. Senate
Hon. John Riegle, Jr., U.S. Senate
Hon. John Conyers, U.S. House of Representatives
Hon. John Dingell, U.S. House of Representatives
Hon. Jack McDonald, U.S. House of Representatives
Hon. Lucien Nedzi, U.S. House of Representatives
Hon. James O'Hara, U.S. House of Representatives
Hon. Charles Diggs, U.S. House of Representatives
Hon. William Ford, U.S. House of Representatives
Hon. William Broonfield, U.S. House of Representatives
Council on Environmental Quality
U.S. Environmental Protection Agency
  Region I
  Region II
  Region III
  Region IV
  Region V
  Region VI
  Region VII
  Region VIII
  Region IX
  Region X
  Facilities Requirement Branch
  Environmental Evaluation Branch
  Office of Public Affairs
  Public Information Reference Unit
  Office of Federal Activities
  Office of Legislature
Department of Defense
  U.S. Army Engineer, Missouri River Division
  U.S. Army Engineer, Ohio River Division
  U.S. Army Engineer, North Central Division
  U.S. Army Engineer, Lower Mississippi River Valley Division

- Department of Transportation
  - Region V
  - U.S. Coast Guard
  - Federal Highway Administration
  - Federal Aviation Administration
  - Federal Railroad Administration
- Department of Interior
  - Bureau of Indian Affairs
  - U.S. Fish and Wildlife Service
  - National Park Service
  - Bureau of Mines
  - Bureau of Land Management
  - Bureau of Outdoor Recreation
- Department of Health, Education and Welfare
  - Office of Environmental Affairs
  - Region V
- Department of Labor
- Department of Housing and Urban Development
- Department of Commerce
- Department of Agriculture
- Advisory Council on Historic Preservation
- Water Resources Council

## 9.4 Media Representatives Notified

- The Oakland Press
- Marine and Recreation News
- Michigan Outdoors
- Detroit Free Press
- Detroit News
- Michigan Chronicle
- Suburban Papers

## 9.5 Organizations and Individuals Notified

- Center for Urban Affairs
- Sierra Club
- Morgan Library, Colorado State University
- League of Women Voters
- Environmental Defense Fund, Inc.
- Izaak Walton League of America
- School of Natural Resources, University of Michigan
- College of Engineering, University of Akron
- National Wildlife Federation
- Natural Resources Defense Council, Inc.
- Dr. Gordon McCallum
- Boyd L. Rasmussen
- Walter R. Courtenay
- Harold Hochmuth
- International Association of Game Fish and Conservation
- St. John Cantius Church

Michigan United Conservation Clubs
Katherine Cushman
McMillum School
Morley School
Joey's Stables
Detroit Audubon Society
Citizens for Survival
Detroit Area Coalition for the Environment
Rouge Basin Coalition
Rescue the Rouge Committee
Citizens of Environmental Action
Friends of Earth
Citizens Action for Clean Water
Limnos
Michigan Environmental Information Center
Soil Conservation Society of America
Citizens for Clean Air
Michigan Lake and Stream Association, Inc.
Michigan Association of Conservation Ecologists
United Steel Workers
United Auto Workers

## 10.0 REFERENCES

This chapter presents the references cited in this environmental impact statement. Other documents have been used but have not been cited.

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# 11.0 TECHNICAL APPENDICES

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# Appendix 11.1

# DESCRIPTION OF FUTURE STUDIES REQUIRED
# AND
# MEMORANDA OF UNDERSTANDING

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## 11.1 Future Studies

### 11.1.1 Final Facilities Plan Studies

#### 11.1.1.1 Combined Sewer Overflow Study

The Consent Judgment (U.S. District Court, 1977 B) requires a combined sewer overflow evaluation. The CSO study will require approximately 2 years to complete. The CSO evaluation will determine the number, quantity, quality, and location of combined sewer overflows. Concurrent with the CSO base data collection, the effect of the CSO upon the receiving stream will be determined, both for dry and wet weather conditions.

This data will provide a factual basis for assessment of the impact of the CSO. The study will identify the particular source of the problems and determine improvements required to ensure the receiving waters will meet applicable water quality standards.

The final step of the CSO study will be to develop a useable data base for a comprehensive stormwater management plan. The final result of this study's efforts, after further analysis, will be an acceptable stormwater management plan for the study area.

#### 11.1.1.2 Capacity and Capability of Existing Plant

The Consent Judgment (U.S. District Court, 1977 B) requires DWSD to investigate the capacity and capability of the existing plant. The capacity and capabilities of the existing plant study will identify needed improvements as a part of the final facilities plan design.

The study requires a detailed evaluation of the systems within the DWWTP to determine the limiting factors both with regards to capacity and capability. The capability of the plant will then be compared to the requirements of the 1983 NPDES permit requirements as set forth in the Consent Judgment (U.S. District Court, 1977, B). The results of this study will determine needed improvements, replacements, and/or modifications to satisfy the 1983 requirements of the NPDES permit.

#### 11.1.1.3 Influent Flow and Characteristics

The Consent Judgment (U.S. District Court, 1977 B) requires that a study of the actual influent flow and characteristics be conducted. The results of the influent study will provide quantitative estimates of daily, weekly, and monthly flow fluctuations st the DWWTP. Influent characteristics including BOD, suspended solids, phosphorus, grit, and others as needed, will be quantified.

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This data will provide quantitative results for the final facilities plan design to assure compliance with the 1983 NPDES permit requirements.

### 11.1.1.4 Identify and Describe Replacement Facilities Required

Many parts, notably the main pumping station and the retangular primaries at the DWWTP are over 20 years old. Additionally, some systems in the DWWTP have never functioned properly and may need replacement rather than modification. Therefore, a value engineering analysis is necessary to evaluate all systems of the DWWTP that are 20 years old or older. Additionally, all systems that have major operational and/or maintenance difficulties will be analyzed using value engineering techniques.

Value engineering analysis determine the total costs of each system for the design period including capital costs, operating costs, and maintenance costs. By performing a value engineering analysis on the existing system and feasible alternatives, that system which is the most efficient and least costly will be determined. This study is a part of the Consent Judgment (U.S. District Court,1977 B) and the facilities planning work required of DWSD. The final results of the study will provide for optimization of the DWWTP to meet the requirements of the NPDES permit.

### 11.1.1.5 Final Facilities Plan Environmental Assessment

The Consent Judgment (U.S. District Court, 1977 B) and U.S. EPA require an environmental assessment to fulfill the National Environmental Policy Act of 1969. The environmental assessment and engineering planning and evaluation will become the final facilities plan to submit to MDNR and U.S. EPA for approval.

The environmental assessment will contain an inventory of existing environmental and engineering alternatives analysis and proposed mitigating measures. The environmental assessment may be prepared concurrently with a "piggyback" EIS to reduce time required for eventual review and approval by U.S. EPA. The "piggyback" process may save as much as a year and a half if an EIS is required.

### 11.1.2 EIS on Final Facilities Plan

Due to the complexity and controversial nature of the DWSD final facilities plan, U.S. EPA will require an EIS (Section 6.4). The Eis may be"piggybacked" with the facilities plan to save the one to two years necessary to prepare an EIS after the final facilities plan is completed.

The EIS will be required to address the main issues of the facilities plan including incineration pilot studies, stormwater management for combined sewer overflows, and plant expansion. The requirements of the NEPA of 1969 must be satisfied by the EIS to allow federal assistance to construct the needed facilities.

The final facilities plan EIS will require several issue oriented sub-reports including: (1) landfill site selection study; (2) North Macomb County sewer needs evaluation; and (3) DelRay Neighborhood analysis.

The completion of the EIS will allow federal participation in constructing the required facilities to be designed under Step II and constructed under Step III grant(s).

### 11.1.2.1 Landfill Site Selection Study

The amount of residuals generated by the DWWTP will require a substantial disposal operation. The present analysis has determined the landfill of residuals to be most environmentally sound and least costly.

The landfill site selection process will identify the requirements of the landfill for the 20 year planning period. Concurrently, the requirements for the landfill site will be determined.

An evaluation of potential sites from environmental, engineering, and cost viewpoints will identify feasible sites for the landfill operation. The evaluation will be a several step process. The final result of this study will provide for site(s) to landfill residuals, and recommendations for operation of the landfill. A major component of the evaluation will be regarding odors and their potential impact.

### 11.1.2.2 North Macomb Needs Study

An issue not resolved in this EIS is the requirements for sewer service in northern Macomb County. A study is needed to analyze the situation. The study will analyze existing conditions, trends, and projects in northern Macomb County. Parameters that require examination include population, land use, economics, industrial growth, and population density. The study of northern Macomb County will provide an independent evaluation of the needs of the Romeo, Armada, and Richmond areas for sewer service.

### 11.1.2.2 DelRay Neighborhood Analysis

As a part of the EIS, an analysis of the DelRay Neighborhood is needed to assess the existing trends and effects of the DWWTP. A major portion of this study will evaluate the existing odors emitted by the DWWTP and their effect upon the neighborhood. The analysis would present tools available to preserve the neighborhood and evaluate their effectiveness. The net result would be recommendations to the City to strengthen and preserve the neighborhood.

## 11.1.3 FORMAT FOR SUBMISSION OF PLAN

### Outline of Plan

The following outline for the plan is suggested. It meets the requirements of the Construction Grants regulation (Appendix B) and follows the planning steps presented in this guidance. Items applicable to a specific case may be deleted.

1. SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

2. INTRODUCTION

    2.1 Study Purpose and Scope
    2.2 Planning Area (Map)

3. EFFLUENT LIMITATIONS (Section 4.1)

4. CURRENT SITUATION (Section 4.2)

    4.1 Conditions in Planning Area

        4.1.1 Planning Area Description
        4.1.2 Organization Context
        4.1.3 Demographic and Land Use Data
        4.1.4 Water Quality and Uses
        4.1.5 Other Environmental Conditions

    4.2 Existing Wastewater Flows and Treatment Systems
    4.3 Infiltration and Inflow
    4.4 Performance of Existing System

5. FUTURE SITUATION (Section 4.3)

    5.1 Land Use
    5.2 Demographic and Economic Projections
    5.3 Forecast of Flow and Waste Load
    5.4 Future Environment of the Planning Area Without the Project

6. ALTERNATIVES (Section 4.4)

    6.1 Optimum Operation of Existing Facilities
    6.2 Regional Solutions
    6.3 Waste Treatment Systems
    6.4 Evaluation (monetary, environmental, implementation)

7. PLAN SELECTION (Section 4.5)

    7.1 Views of Public and Concerned Interest on Alternatives
    7.2 Evaluation and Ranking of Proposals
    7.3 Selected Plan (major feature summary) and Reasons for Selection
    7.4 Environmental Impacts of Selected Plan

8. COST ESTIMATES, PRELIMINARY DESIGNS (Section 4.6)

8.1 Description of Design, with Maps
8.2 Summary of Cost Estimates

9. ARRANGEMENTS FOR IMPLEMENTATION (Section 4.7)

9.1 Institutional Responsibilities
9.2 Implementation Steps
9.3 Operation and Maintenance
9.4 Financial Requirements

10. SUMMARY OF ENVIRONMENTAL CONSIDERATIONS (Section 7)

10.1 Existing Environmental Conditions
10.2 Future Environment Without the Project
10.3 Evaluation of Alternatives
10.4 Environmental Effects of Selected Plan

Appendices

The following information, cross-referenced in the text of the plan, may be placed in appendices:

a. Preliminary designs, technical data and cost estimates for alternatives.

b. Agreements, resolutions, and comments.

c. Supplemental engineering feasibility data on the details of the adopted plan.

d. Infiltration/inflow analysis.

e. Sewer evaluation surveys.

f. Copy of the permit for the facilities.

For a simple planning situation, the information included in items (a) and (c) may be incorporated in the main report.

The technical appendices (c) should include, but not necessarily be limited to:

a. Description of the configuration of collector and interceptor systems, profiles, sizes, and cost breakdowns.

b. Treatment plant data, including site plan, layouts of unit processes, flow charts, design, and performance data.

## Appendix 11.1

## Detroit Water & Sewerage Department

## Air Pollution Abatement Program

This program supersedes the August 1976 Memo of Understanding with Wayne County Air Pollution Control Division.

I. Complex I & II Incinerators 1 - 14

  A. Scrubber Upgrade and Incinerator Modifications

    1. General

      a. DWSD agrees to upgrade Incinerators 1 - 6 in Complex I to meet an emission limit of 1.3 lbs. particulate (dry)/ton dry sludge or 0.15 lbs. particulate (including condensibles)/ 1,000 lbs. flue gas corrected to 50% excess air, whichever is more stringent.

    2. The following schedule shall be followed in order to achieve the emission limitations in the foregoing section IA1.

      a. First Incinerator

        (1) On-Site construction started August, 1977
        (2) Complete on-site construction by February 3, 1979
        (3) Achieve compliance with said emission rate by March 1, 1979
        (4) Submit emission test results by April 2, 1979

      b. Second Incinerator

        (1) On-site construction started October, 1977
        (2) Complete on-site construction by May 21, 1979
        (3) Achieve compliance with said emission rate by June 21, 1979
        (4) Submit emission test results by July 22, 1979

      c. Third Incinerator

        (1) Initiate on-site construction by February 4, 1979
        (2) Complete on-site construction by September 11, 1979
        (3) Achieve compliance with said emission rate by October 11, 1979
        (4) Submit emission test results by November 10, 1979

d. Fourth Incinerator

  (1) Initiate on-site construction by May 22, 1979
  (2) Complete on-site construction by December 29, 1979
  (3) Achieve compliance with said emission rate by January 29, 1980
  (4) Submit emission test results by February 28, 1980

e. Fifth Incinerator

  (1) Initiate on-site construction by September 12, 1979
  (2) Complete on-site construction by April 17, 1980
  (3) Achieve compliance with said emission rate by May 19, 1980
  (4) Submit emission test by June 17, 1980

f. Sixth Incinerator

  (1) Initiate on-site construction by January 2, 1980
  (2) Complete on-site construction by August 6, 1980
  (3) Achieve compliance with said emission rate by September 8, 1980
  (4) Submit emission test results by October 5, 1980

B. Enhancement of Stack Dispersion

1. DWSD shall implement further control and dispersion enhancement from Complexes I & II incinerators that will result in a maximum 24 hour ground level concentration therefrom of not more than 35 $\mu g/m^3$ at the plant boundaries on a once in five year basis. DWSD will optimize the control and dispersion enhancement to meet the 35 $\mu g/m^3$ goal on the schedule outlined in section I.B.2. below. Future air quality modeling will be identical to the modeling completed in the Segmented Facilities Plan and used to select the 35 $\mu g/m^3$ goal.

2. Schedule

   a. By April 1, 1979, DWSD shall submit a report identifying methodology acceptable to the Air Quality Division, Department of Natural Resources (Air Pollution Control Division, Wayne County Health Department) that the DWSD will implement to achieve the aforementioned goal of 35 $\mu g/m^3$. The report shall also include adequate documentation to demonstrate that the ground level concentration of 35 $\mu g/m^3$ can be achieved.

   b. By June 1, 1980, DWSD shall award contracts for such control and dispersion enhancement.

   c. By June 1, 1981, DWSD shall initiate on site construction of stack dispersion equipment.

   d. Complete first two units in each complex by November 1, 1981.

   e. Complete second two units in each complex by April 1, 1982.

   f. Complete third two units in each complex by October 1, 1982.

   g. Complete last two units in Complex II by December 31, 1982.

C. Emission Deductions - Complex II

DWSD agrees to reduce particulate emissions to meet the applicable emission standard of 0.2 lbs particulate (including condensibles) per 1,000 lbs exhaust gases corrected to 50% excess air. The following program and schedule will be followed:

1. Submit final control plan by September 1, 1978.
2. Compliance with above emission rate by May 1, 1979.
3. Submit test results by June 1, 1979.

II. Long Range Improvements - Complexes I & II

DWSD agrees to further implement air quality control improvements for Complexes I & II incinerators that will achieve improved emission rates, improved unit productivity energy conservation, higher effiency emissions abatement equipment, lower maintenance costs, improved sludge feed system and elimination of downwash. All emission control equipment in Complexes I & II shall at least meet a limit of 1.3 lbs/ton dry sludge or 0.15 lb/1000 lbs., whichever is more stringent.

III. Complex III

Nothing in this agreement shall be construed, either direct or implied, that approval for any additional incinerator capacity beyond that presently existing at Complexes I and II is granted.

(3/21/78)

## Appendix 11.2

## RARE, THREATENED AND ENDANGERED SPECIES

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# Rare, Threatened, and Endangered Species
# Which May Be Found in the Study Area

## Plant

*Nelumbo lutea*, American Lotus

## Animals

Pelecypoda, Mussels
- *Anodonta Grandis*
- *Carunculina glans*
- *Cyclonaias tuberculata*
- *Dysnomia sulcata* or *D. perplexa rangiana*
- *D. triqueta*
- *Elliptio dialatatus*
- *Lampsilis fasciola*
- *L. ventricosa*
- *Leptodea fragilis*
- *Ligumia nasuta*
- *Obliquaria reflexa*
- *Obovaria leibi* or *O. subrotunda*
- *Pleurobema cordatum*
- *Ptychobranchius fasciolaris*
- *Quadrula quadrula*
- *Simpsoniconcha ambigua*
- *Villosa fabilis* or *Micromya fabilis*

Gastropoda, Snails
- *Amnicola binneyana* or *Cincinnatia emarginata*
- *A. integra*
- *Somatogyrus subglobosus*

Insecta
- *Hexagenia limbata*, Mayfly
- *H. rigida*, Mayfly
- *Oecetis inconspicua*, Caddisfly

Crustacea
- *Limnocalanus macrurus*
- *Mysis relicta* or *M. oculata relicta*, Opossum Shrimp

Fish
- *Ichtyomyzon fossor*, Northern Brook Lamprey
- *I. unicuspis*, Silver Lamprey
- *Lampetra lamottei*, American Brook Lamprey
- *Acipenser fulvescens*, Lake Sturgeon
- *Polydon spathula*, Paddlefish
- *Lepisosteus oculatus*, Spotted Gar
- *Salvelinus namaycush*, Lake Trout
- *Coregonus alpenae*, Longjaw Cisco

*C. artedi*, Cisco, Lake Herring, Shallowwater Cisco
*C. clupeaformis*, Lake Whitefish
*Hiodon tergisus*, Mooneye
*Esox masquinongy*, Muskellunge
*Clinostomus elongatus*, Redside Dace
*Hybopsis storeiana*, Silver Chub
*Nocomis micropogon*, River Chub
*Notropis anogenus*, Pugnose Shiner
*N. ariommus*, Popeye Shiner
*N. boops*, Bigeye Shiner
*N. buchanani*, Ghost Shiner
*N. dorsalis*, Bigmouth Shiner
*N. emiliae*, Pugnose Minnow
*N. heterodon*, Blackchin Shiner
*N. heterolepis*, Blacknose Shiner
*N. photogenis*, Silver Shiner
*Rhynichthyes cataractae*, Longnose Dace
*Catostomus catostomus*, Longnose Sucker
*Erimyzon sucetta*, Lake Chubsucker
*Lagochila lacera*, Harelip Sucker
*Moxostoma hubbsi*, Copper Redhorse (1)
*M. valenciennesi*, Greater Redhorse
*Noturus stigmosus*, Northern Madtom
*Fundulus diaphanus*, Banded Killifish
*Lota lota*, Burbot
*Aphredoderus sayanus*, Pirate Perch
*Ammocrypta pellucida*, Northern Sand Darter
*Etheostoma exile*, Iowa Darter
*E. nigrum eulepis*, Scaly Johnny Darter
*Percina copelandi*, Channel Darter
*P. evides*, Gilt Darter
*P. shumardi*, River Darter
*Stizostedion canadense*, Sauger
*S. vitreum glaucum*, Blue Pike
*Cottus bairdi*, Mottled Sculpin
*C. ricei*, Spoonhead Sculpin
*Myoxocephalus quadricornus*, Fourhorned Sculpin (2)

(1) Present in St. Lawrence River
(2) Present in Lake Ontario, distinct deepwater form

# APPENDIX 11.3

## A Model for Calculating the Land Requirements of a Sludge Application Program

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## Introduction

The two constituents of sewage sludge which most often limit its application to croplands are nitrogen and heavy metals. Excessive quantities of nitrogen can cause nitrate contamination of groundwater, while high concentrations of heavy metals in the soil can result in their entering the food chain. However, if these two constituents are properly controlled, land application can be a safe, environmentally sound method of sludge disposal.

This appendix presents a simple model which can be used to calculate the minimum amount of land which is required for conducting a sludge application program. This will allow preliminary determinations to be made of the feasibility and cost-effectiveness of land application alternatives for sludge disposal.

## Nitrogen

Nitrogen is present in sewage sludge in both the organic and inorganic forms. Typical digested sewage sludge contains from 1 to 5 percent organic nitrogen by dry weight and from 1 to 3 percent inorganic nitrogen (Sommers and Nelson, 1976).

Nitrogen is a nonconservative substance in soils and is constantly changing form. Biological activity will break down organic nitrogen into the inorganic form where it will oxidize to nitrate, which is utilized by vegetation as a nutrient. Numerous other reactions, such as nitrogen fixation, also occur, and some nitrogen is contained in rainfall.

Soil contains 400 to 10,000 kg/ha of nitrogen (Haith, 1973), mostly in the organic form. From 2 to 10 percent of the soil organic nitrogen will mineralize each year.

When sludge is applied to land, the inorganic nitrogen fraction is readily available for uptake by crops. Sommers and Nelson, (1976) estimates that 15 percent of the sludge's organic nitrogen will become available the first year, with 3 percent of the remainder becoming available for at least three suceeding years.

Uptake by crops is a major mechanism for nitrogen removal from soil. Sommers and Nelson, (1976), presented estimates of the nitrogen requirements of typical crops. Removal of nitrogen by crop uptake assumes that the crop is removed from the site by harvesting.

Leaching of soluble nitrate nitrogen to groundwater is another removal mechanism. Any inorganic nitrogen in excess of that needed for crop uptake can potentially leach into the groundwater. The USEPA drinking water standard for nitrate nitrogen is 10 mg/l.

Taking sources and sinks into account, an annual nitrogen mass balance can be expressed as:

Soil nitrogen which is mineralized
+ Sludge organic nitrogen which is mineralized
+ Sludge inorganic nitrogen
+ Other nitrogen additions, such as rainfall
- Nitrogen uptake of crops
- Nitrogen lost in leachate
= 0

This mass balance can be expressed mathematically by assuming that a fraction of the sludge organic nitrogen mineralizes the first year and that the remainder becomes part of the soil organic nitrogen; the soil organic nitrogen also mineralizes, but not necessarily at the same rate as the sludge organic nitrogen.

$$b\ N_s\ (n) + a\ F_o\ A\ (n) + F_i\ A\ (n) + R - U - G = 0 \qquad \text{Equation 1}$$

where

$N_s\ (n)$ = Soil organic nitrogen, kg/ha, at the start of year n
$A\ (n)$ = Amount of sludge applied, kg/ha, in year n
$a$ = Fraction of the sludge organic nitrogen which is mineralized in the first year the sludge is applied, $\text{year}^{-1}$
$b$ = Fraction of the soil organic nitrogen which is mineralized each year, $\text{year}^{-1}$
$F_o$ = Fraction of organic nitrogen in the sludge
$F_i$ = Fraction of inorganic nitrogen in the sludge
$R$ = Additions of nitrogen from rainfall or commercial fertilizer applications, kg/ha/yr
$U$ = Uptake of inorganic nitrogen by crops, kg/ha/yr
$G$ = Inorganic nitrogen lost in leachate, kg/ha/yr

Rearranging equation 1 gives the maximum amount of sludge that can be applied in any year, based on nitrogen limitations:

$$\text{Amax}\ (n) = \frac{\text{Gmax} + U - R - b\ N_s\ (n)}{a\ F_o + F_i} \qquad \text{Equation 2}$$

where

Amax(n)= Maximum amount of sludge, kg/ha, which can be applied in year n
Gmax = Maximum allowable loss of nitrogen through leaching, based on water quality standards for groundwater

The soil organic nitrogen will be augmented by the part of the sludge organic nitrogen which is not mineralized in the first year:

$$N_s\ (n + 1) = [1-b]\ N_s\ (n) + [1-a]\ F_o\ An \qquad \text{Equation 3}$$

By using equations 2 and 3, it is possible to calculate the maximum sludge application rate for each successive year of land application. This technique will be demonstrated after limitations on heavy metals are discussed.

## Heavy Metals

Unlike nitrogen, heavy metals behave as conservative substances. That is, once placed in the soil, they will tend to remain in place and accumulate. Concentrations must not be allowed to become excessive and the soil pH must remain sufficiently high to avoid solubilization of heavy metals. Thus, while nitrogen limits annual sludge application rates, heavy metals limit the total amount of sludge which can be applied to a given plot of land.

Table A-1 shows the concentrations of heavy metals in sludge from the DWWTP compared to ranges of concentrations found in other sludges. Table A-2 shows the total amounts of sludge metals allowed on agricultural lands; other limits may be appropriate for non-agricultural lands or if supported by a monitoring program for heavy metals.

The maximum total of sludge which can be applied is:

$$A_H = \text{Min} \left[ \begin{array}{l} 2.27 \times 10^9/F_{Pb} \\ 1.12 \times 10^9/F_{Zm} \\ 5.60 \times 10^8/F_{Cu} \\ 2.24 \times 10^8/F_{Ni} \\ 2.24 \times 10^7/F_{Cd} \end{array} \right. \qquad \text{Equation 4}$$

where

$A_H$ = Maximum amount of sludge, kg/ha, which can be applied, based on heavy metals limitations

$F_{Pb}$, $F_{Zm}$, $F_{Cu}$, $F_{Ni}$, $F_{Cd}$ = Fractions (dry weight) of lead, zinc, copper, nickel and cadmium, respectively, in the sludge, ppm

Note: Equation 4 assumes a soil with a cation exchange capacity greater than 15 meq/100 g. For soils with a CEC of 5 to 15 meq/100 g, the rates shown should be halved; for CEC less than 5 meq/100 g, the allowable rates are one quarter those shown.

Table A-1. Trace Element Concentrations in Sewage Sludge [Source: "Ohio Guide for Land Application of Sewage Sludge," Ohio Agricultural Research and Development Center, Ohio Cooperative Extension Service, July, 1975.]

| Element | Range (ppm*, dry wt.) | Median** | Detroit*** |
|---|---|---|---|
| Boron | 6-1000 | 50 | - |
| Cadmium | 1-1500 | 10 | 115 |
| Chromium | 20-40,600 | 200 | 1295 |
| Cobalt | 2-260 | 10 | - |
| Copper | 52-11,700 | 500 | 1191 |
| Nickel | 10-5300 | 50 | 1392 |
| Manganese | 60-3900 | 500 | - |
| Mercury | 0.1-56 | 5 | 7 |
| Molybdenum | 2-1000 | 5 | - |
| Lead | 15-26,000 | 500 | 1090 |
| Zinc | 72-49,000 | 2000 | 5710 |

* Parts per million

** The median is that value for which 50 percent of the observations, when arranged in the order of magnitude, lie on each side.

*** Raw dewatered sludge

Table A-2. Maximum Amounts of Sludge Metals Allowed on Agricultural Land. [Source: Sommers and Nelson, 1976.]

| | Soil Cation Exchange Capacity (meq/100 g)* | | |
|---|---|---|---|
| Metal | 0-5 | 5-15 | > 15 |
| | Maximum Amount of Metal (Lb./Acre) | | |
| Pb | 500 | 1000 | 2000 |
| Zn | 250 | 500 | 1000 |
| Cu | 125 | 250 | 500 |
| Ni | 50 | 100 | 200 |
| Cd | 5 | 10 | 20 |

* Determined by the pH 7 ammonium acetate procedure

One further heavy metals limitation which must be considered is the need to limit cadmium to 2.24 kg/ha/y (Sommers et al., 1976). This results in the following limitation:

$$A_{max} \leq 2.24 \times 10^6 / F_{Cd} \qquad \text{Equation 5}$$

## Maximum Sludge Application Rates

The maximum amount of sludge which can be applied to a parcel of land can be calculated by alternately solving equations 2 and 3 (or 5 and 3, if Cadmium limits), as the flow diagram in Figure A-1 shows. Sludge applications must cease when $A_H$ is reached.

Maximum application rates for composted sludge from the DWWTP were calculated, using the assumptions shown in Table A-3.

## Land Requirements

The minimum amount of land required for a sludge application program can be calculated by assuming that each parcel of land will be used to the greatest extent possible before acquiring any new land. As shown previously, the capacity of land to accept sludge decreases each year as organic nitrogen is added to the soil, and applications must eventually cease when the heavy metals limit is attained. Thus, even if the quantity of sludge produced were to remain constant, additional land would be needed each year to allow for this decreasing capacity to accept sludge.

In the first year of application, the maximum amount of sludge which can be applied to a parcel of land of a given size is described by Equation 5a. In the second year of application, this first parcel of land has a smaller ability to accept sludge, so more land is needed as shown in Equation 5b. This process continues for each year:

$$S(1) = L(1)\,A(1) \qquad \text{[Equation 5a]}$$

$$S(2) = L(1)\,A(2) + L(2)\,A(1) \qquad \text{[Equation 5b]}$$

$$S(3) = L(1)\,A(3) + L(2) + L(3)\,A(1) \qquad \text{[Equation 5c]}$$

$$\vdots$$

$$S(n) = L(1)\,A(n) + L(2)\,A(n-1) \ldots L(n)\,A(1) \qquad \text{[Equation 5d]}$$

where

$S(n)$ = Amount of sludge, kg, applied in year n
$L(n)$ = Amount of land, ha, for which sludge applications start in year n

Figure A-1. Flow diagram for calculating the maximum sludge application rate for each year.

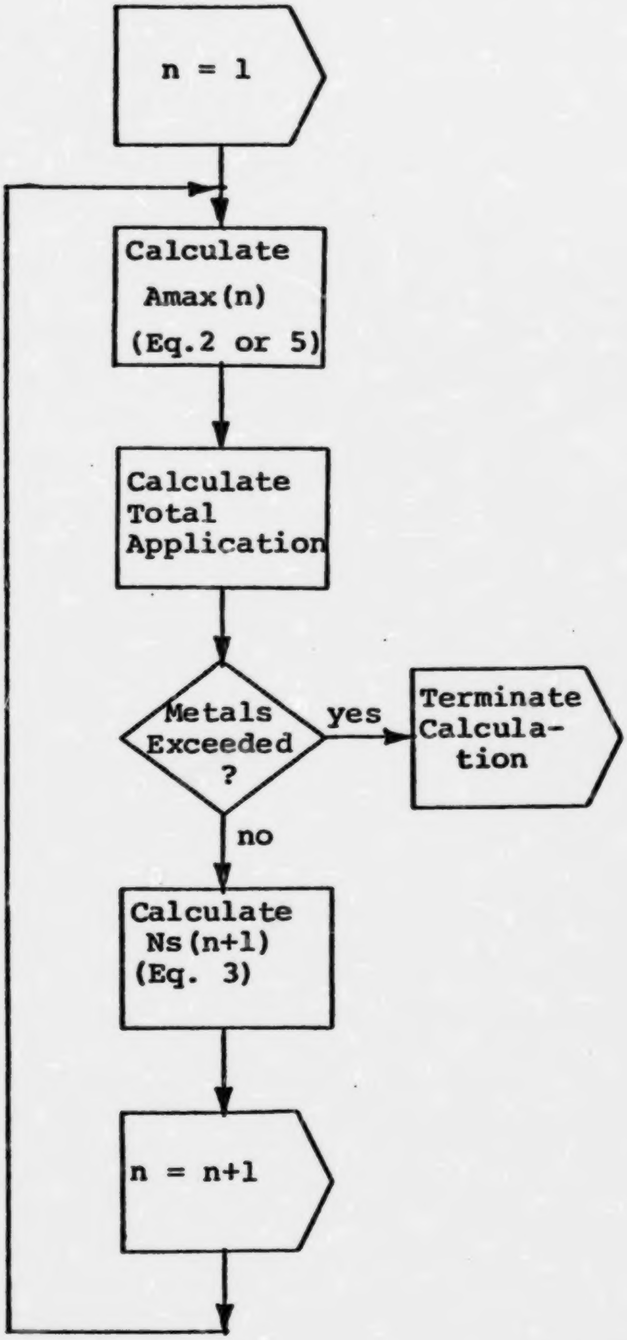
n = 1
Calculate
Amax(n)
(Eq.2 or 5)
Calculate
Total
Application
Metals
Exceeded
?
yes
Terminate
Calcula-
tion
no
Calculate
Ns(n+1)
(Eq. 3)
n = n+1

Table A-3. Example of calculating maximum rates of application.

Data and Assumptions

Type of sludge: Composted

Characteristics:

Organic Nitrogen = 0.99%
Inorganic Nitrogen = 0.14%
Copper = 659 ppm
Nickel = 769 ppm
Zinc =3148 ppm
Cadmium = 717 ppm
Lead = 602 ppm
Mercury = 3.8 ppm

Initial Soil Organic Nitrogen, $N_s(1)$ = 3400 kg/ha

Crop Nitrogen Uptake, U = 220 kg/ha.y

Rainfall Nitrogen Input, R = 7 kg/ha.y

Nitrogen Leaching, G = 2 kg/ha.y

Mineralization, first year, a = 0.15

Mineralization, succeeding years, b = 0.03

Calculations:

Maximum Total Application, $A_H$ = 291,000 kg/ha (based on nickel)

Maximum Yearly Application, based on cadmium = 35,000 kg/ha.y

| Year | Rate of Application kg/ha | Limitation |
|---|---|---|
| 1 | 35,000 | Cadmium |
| 2 | 35,000 | Cadmium |
| 3 | 35,000 | Cadmium |
| 4 | 33,300 | Nitrogen |
| 5 | 31,700 | Nitrogen |
| 6 | 30,200 | Nitrogen |
| 7 | 28,900 | Nitrogen |
| 8 | 27,700 | Nitrogen |
| 9 | 26,700 | Nitrogen |
| 10 | 7,570 | Nickel |
| 11... | 0 | Nickel |

A (n) = Sludge application rate, kg/ha.yr, after n years of applications, defined in previous sections

Equations 5a through 5d can be solved successively to find the amount of land needed to be added each year.

$$L(1) = S(1)/A(1) \qquad \text{[Equation 6a]}$$

$$L(2) = [S(2) - L(1)\,A(2)]/A(1) \qquad \text{[Equation 6b]}$$

$$L(3) = [S(3) - L(1)\,A(3) - L(2)\,A(2)]/A(1)$$

$$\vdots$$

$$L(n) = \left[S(n) - \sum_{i=1}^{n-1} \Big(L(n-i)\,A(i+1)\Big)\right] /A(1) \qquad \text{[Equation 6d]}$$

Table A-4 presents an example of how these equations would be used to estimate land requirements for spreading the composted sludge of Table A-3 . The total amount of compost produced was projected to increase from 3.695 x $10^8$ kg/y in 1980 to 4.643 x $10^8$ kg/y in 1999. Note how the initial land purchased in 1980 needs only small annual increments until 1989, when it begins to become saturated with heavy metals; at this point more extensive purchases of land are necessary.

## Conclusions

The ability of land to accept sludge without adverse environmental impacts will vary from year to year, depending upon previous applications of sludge. This variation will affect the size of a sludge application program, equipment requirements and annual costs. Because allowable annual sludge loadings will vary, a strong management system is recommended for any land application program in order to avoid adverse impacts.

Table A-4. Minimum Amounts of Land Required for Applying Composted Sludge from Detroit to Corn and Cover Crops.

| Year | Land Added to Program ha | Active Spreading Area ha | Total Land in Program ha |
|---|---|---|---|
| 1980 | 10 557 | 10 557 | 10 557 |
| 1981 | 135 | 10 692 | 10 692 |
| 1982 | 136 | 10 828 | 10 828 |
| 1983 | 635 | 11 463 | 11 463 |
| 1984 | 650 | 12 113 | 12 113 |
| 1985 | 596 | 12 709 | 12 709 |
| 1986 | 573 | 13 282 | 13 282 |
| 1987 | 556 | 13 838 | 13 838 |
| 1988 | 539 | 14 377 | 14 377 |
| 1989 | 6 019 | 20 396 | 20 396 |
| 1990 | 2 620 | 12 459 | 23 016 |
| 1991 | 377 | 12 701 | 23 393 |
| 1992 | 907 | 13 472 | 24 300 |
| 1993 | 1 121 | 13 958 | 25 421 |
| 1994 | 1 056 | 14 364 | 26 477 |
| 1995 | 1 009 | 14 777 | 27 486 |
| 1996 | 988 | 15 192 | 28 474 |
| 1997 | 969 | 15 605 | 29 443 |
| 1998 | 3 809 | 18 875 | 33 252 |
| 1999 | 3 091 | 15 947 | 36 343 |

Compost applied in 1980: $3.695 \times 10^8$ kg dry weight

Compost applied in 1999: $4.643 \times 10^8$ kg dry weight

# APPENDIX 11.4

# Evaluation of Existing Unit Processes at the DWWTP (6-1-77)

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## Existing Unit Processes at the DWWTP
(6-1-77)

| Unit Process | Purpose | Existing Equipment | Capacity | Performance/ Problems |
|---|---|---|---|---|
| Preliminary Treatment | Pumping and removal of grit and large objects. | | | |
| Raw Sewage Pumping | Provide energy for flow through plant. | 8 vertical mixed-flow centrifugal pumps. | rated = 1,300 mgd<br>actual = 1,220 mgd | Controls are being rehabilitated. Other minor problems and safety hazards exist. |
| Screening | Remove rags and large objects. | 8 bar racks with mechanical rakes. | - | Electrical equipment in poor condition; some parts no longer available. Differential pressure system is not used. |
| Grit Removal | Remove heavy particles, prevent abrasion | 3 mechanically cleaned grit channels. | velocity = 1 fps at 1,300 mgd | Sluice gates on discharge are a maintenance problem. |
| Primary Treatment | Remove suspended solids and flotables | | | |
| Clarification | Provide quiescent flow conditions to allow solids to settle and grease to float | 12 rectangular tanks, Total Surface Area=367,000 ft$^2$ Total Volume=24.5 mil/gal<br>2 circular tanks Total Surface Area=98,000 ft$^2$ Total Volume=25 mil/gal (two more circular tanks are being added). | design = 1,050 mgd (1,300 mgd with 4 circular tanks) | Good suspended solids removal efficiencies. (76% removal when effects of recycle are included). Poor control of flow to tanks. Operating availability is only 60 to 70 percent. |

Existing Unit Processes at the DWWTP
(6-1-77)

| Unit Process | Purpose | Existing Equipment | Capacity | Performance/ Problems |
|---|---|---|---|---|
| Primary Treatment (Cont.) | | | | |
| Grease and Skimmings Collection | Remove flotables from clarifiers. | Rectangular tanks have chain and flight collectors. Circular tanks have scum collector arms. | | Estimated 21% grease removal, based on 2 months data. Many operational problems. Scum removal system of circular tanks works very poorly. |
| Sludge Collection | Remove sludge from clarifiers. | Sludge pumps and controls. | Design: 490,000 lbs/day removed | Sludge often becomes too thick to pump, due to poor control procedures. |
| Secondary Treatment | Remove organic material. | | | |
| Intermediate Pumping | Provide energy for flow through secondary treatment. | Two variable speed 2,000 HP pumps | Design: 600 mgd | Moderate flow control problems. |
| Aeration | Microorganisms assimilate organic material in wastewater. | Two basins: Air activated sludge, pure oxygen activated sludge. Two additional oxygen basins under construction | Design: 150 mgd (air) 300 mgd (oxygen) & 600 mgd expansion. | Liquid level fluctuates. Can maintain good mixing and high oxygen levels in all parts of basins. |

Existing Unit Processes at the DWWTP
(6-1-77)

| Unit Process | Purpose | Existing Equipment | Capacity | Performance/ Problems |
|---|---|---|---|---|
| Secondary Treatment (Cont.) | | | | |
| Final Clarification | Separate activated sludge from wastewater, and thicken. | 200' diam clarifiers:<br>9 - operating<br>12 - under construction<br>4 - scheduled<br>25<br>Overflow rate = 1,600 gpd/ft$^2$ | Design: 50 mgd per clarifier or 1,200 mgd with one clarifier out of service | Major design flaw; units cannot thicken sludge properly before it is returned to aeration basins. Unable to maintain more than 2,500 to 3,000 mg/l in either air or oxygen system. Because of this problem, effluent limits cannot be attained on a consistent basis. |
| Return Sludge Pumping | Remove sludge from final clarifiers. | Four (4) drawoff arms per clarifier, and one (1) 125 HP variable speed pump. | Design: 25 mgd<br>Actual: 19-21 mgd | Pumps are not able to perform at design capacity. |
| Sludge Wasting | Remove biomass from activated sludge system. | Six pumps @ 4.5 mgd | Design: 27 mgd | |
| Skimming | Remove flotables from clarifiers. | Two (2) skimming arms per clarifier return skimmings to the Jefferson Avenue Interceptor. | | |
| Oxygen Generation | Provide oxygen to oxygen aeration tanks. | Cryogenic oxygen plant | 178 ton/day | May have excess capacity. |
| Blowers | Provide air to air aeration tanks. | Two (2) 7,000 HP centrifugal blowers. | 105,000 cfm per blower | Originally sized for 300 mgd; cannot throttle down to efficient operating level. |

Existing Unit Processes at the DWWTP
(6-1-77)

| Unit Process | Purpose | Existing Equipment | Capacity | Performance/ Problems |
|---|---|---|---|---|
| Disinfection | Destroy pathogens. | | | |
| Chlorine Storage | Store chlorine. | Railroad Tank Cars. | 90 tons each | |
| Chlorine Feed | Evaporate and feed chlorine gas at a controlled rate. | 11 evaporators;<br>11 chlorinators. | 100,000 lb/day | Manual adjustment of feed rate is inefficient. |
| Chlorine Contact | Provide time for chlorine to destroy pathogens. | Conduit to Detroit River. | 17 minutes @ 1100 mgd | Solids deposition in outfall, due to low velocities. |
| Phosphorus Removal | Precipitate and settle phosphorus. | | | |
| Chemical Storage | Store polymer and pickle liquor ($FeCl_2$). | 4 lined Tanks for $FeCl_2$;<br>2 silos for polymer. | 650,000 gal.<br>2,500 cu. ft. | |
| Chemical Feed | Feed chemicals at a controlled rate. | 5 pumps for $FeCl_2$;<br>6 pumps for polymer. | ≈300 gpm<br>360 gpm | Poor control of feed rate. |
| Mixing and Flocculation | Mix chemicals with waste and allow formation of floc. | Mixing of $FeCl_2$ in main pumps;<br>Polymer is added before primary tanks. | | |

Existing Unit Processes at the DWWTP
(6-1-77)

| Unit Process | Purpose | Existing Equipment | Capacity | Performance/ Problems |
|---|---|---|---|---|
| Sludge Treatment | | | | |
| Thickening | Concentrate sludge | 6 gravity thickeners. | | Can achieve satisfactory thickening if operated properly. |
| Blending | Mix primary and waste activated sludges. | 2 blending Tanks + 3 under construction | 1600 gpm each | Should be adequate. |
| Storage | Equalize variations in sludge production. | 6 tanks | 1,3000,000 gal. | Will be adequate. |
| Conditioning | Improve dewatering properties of sludge. | Polymer Feed | | |
| Dewatering | Reduce water content of sludge. | Complex I: 12 vacuum filters<br>Complex II: 16 vacuum filters | design≈48-72tph<br>design≈108 tph | Very good performance, but high down time. Quality of filter cake is inconsistent due to poor control. |
| | Evaporate water content of sludge. | Complex I: 6 incinerators;<br>Complex II: 8 incinerators. | I: 12 tph each<br>II: 18 tph each | Inadequate control system results in wasted fuel.<br>Source of air pollution. |

### Existing Unit Processes at the DWWTP
(6-1-77)

| Unit Process | Purpose | Existing Equipment | Capacity | Performance/ Problems |
|---|---|---|---|---|
| Residual Disposal | Prepare resuduals for removal from site. | | | |
| Screenings disposal | | Container storage, haul to sanitary landfill. | design: 25 TPH | Replacement parts not available. |
| Grit disposal | | Storage bin, incinerate with sludge. | design: 25 TPH | Many operating problems. |
| Ash disposal | | Pneumatic ash handling, storage in hoppers. | design: 85 TPH | Minor problems. |
| Grease and skimmings disposal | | Water hearth grease incinerator. | | Many operating problems. |

# APPENDIX 11.5

## Suburban Wastewater Districts Serving Individual Communities

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Suburban Wastewater Districts Serving Individual Communities

| Individual Communities | Area [illegible] Acres | | | Population | | | Maximum Allowable Flow | No. of Metering Points | Major Interceptor Used | Overflows |
|---|---|---|---|---|---|---|---|---|---|---|
| | Combined | Separate | Total | Combined | Separate | Total | | | | |
| City of Allen Park* | - | 960<br>(390 ha) | - | - | 3800 | 42,250 | 0.4 cfs /1000 people @ each of three connection points (0.01m$^3$/s) | 3 | Northwest Interceptor | |
| City of Centerline | - | 1,120<br>(450 ha) | 1,120<br>450 ha) | - | 10,600 | 10,600 | 0.65 cfs/1000 people (0.02m$^3$/s) | 1 | Conner Creek system to Detroit River Interceptor | |
| City of Dearborn | 13,590<br>(5500 ha) | 2,090<br>(850 ha) | 15,660<br>(6340 ha) | 103,000 | 1,000 | 104,000 | 100 cfs (3m$^3$/s) | 2 | Northwest Interceptor | 22 overflow points into the Middle and Main Rouge River. |
| City of Farmington** | 640<br>(260 ha) | 440<br>(180 ha) | 1,080<br>(440 ha) | 5,000 | 5,100 | 13,000 | 6.5 cfs (0.2m$^3$/s) | 1 | Northwest Interceptor | 21" pipe to the Upper Rouge. |
| City of Grosse Pointe | 260<br>(110 ha) | 410<br>(170 ha) | 864<br>(350 ha) | 3,600 | 4,000 | 6,600 | all flow | None | Fox Creek Enclosure | |
| City of Grosse Pointe Farms | 1,713<br>(690 ha) | - | 2050<br>(830 ha) | 12,286 | - | 12,600 | all flow | None | Fox Creek Enclosure | via Conner Creek Enclosure to the Detroit River and/or via Fox Creek open channel drain to Lake St. Clair. |

Suburban Wastewater Districts Serving Individual Communities

"continued"

| Individual Communities | Area in Acres | | | Population | | | Maximum Allowable Flow | No. of Metering Points | Major Interceptor Used | Overflows. |
|---|---|---|---|---|---|---|---|---|---|---|
| | Combined | Separate | Total | Combined | Separate | Total | | | | |
| City of Grosse Pointe Park | 1,600<br>(650 ha) | - | 1,600<br>(650 ha) | 16,000 | - | 16,000 | 84 cfs ($2m^3/s$) | 2 | Detroit River Interceptor | Fox Creek open channel to Lake St. Clair, however, no known overflow points in the internal sewer system. |
| City of Hamtramck | 1,340<br>(540 ha) | - | 1,340<br>(540 ha) | 26,300 | - | 26,300 | all flow | None | Detroit River Interceptor | |
| City of Highland Park | 1,920 | - | 1,920 | 32,000 | - | 32,000 | <10-year storm | None | Detroit River Interceptor | Three connections located on 6 Mile Road. |
| City of Melvindale | | 1,730<br>(700 ha) | 1,730<br>(700 ha) | - | 13,500 | 13,500 | 0.5 cfs/1000 people into the Northwest Interceptor. ($0.01m^3/s$)<br>0.92 cfs from Kropp Forge Plant ($0.03m^3/s$) | None | Northwest Interceptor | An outfall sewer to the Rouge River can be utilized as an overflow when the flow can't be pumped through the 16" Force Main. |

# APPENDIX 11.6

## Suburban Wastewater Districts Serving Multiple Communities

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## SUBURBAN WASTEWATER DISTRICTS SERVING MULTIPLE COMMUNITIES

| Sanitary District | Area in Acres | | | Population | | | Maximum Allowable Flow | No. of Metering Points | Major Interceptor Used | Overflows |
|---|---|---|---|---|---|---|---|---|---|---|
| | Combined | Separate | Total | Combined | Separate | Total | | | | |
| Rouge Valley Sewage Disposal District - Wayne County | 13,980<br>(5660 ha) | 78,760<br>(31,870ha) | 175,700<br>(71,100ha) | 145,520 | 452,770 | 614,200 | 230 cfs<br>94.5 cfs | 2 | Oakwood-Northwest Interceptor | Approximately 40 overflow points along the Lower and Middle Rouge. |
| Northeast Wayne County Sanitary District | 2,740<br>(1110 ha) | 1980<br>(800 ha) | 4720<br>(1910 ha) | 24,400 | 21,360 | 45,760 | 127 cfs | 1 | Detroit River Interceptor | Milk River Detention Basin to Lake St. Clair. |
| South Macomb Sanitary District | 4520<br>(1830 ha) | 12,420<br>5030 ha) | 16,940<br>(6860 ha) | 61,800 | 139,000 | 202,000 | 127 cfs ($4m^3/s$) | 1 | Detroit River Interceptor | Chapaton & Martin retention basins to Lake St. Clair. |
| Macomb Sanitary District | 10<br>(4 ha) | 46,200<br>(18,700ha) | 119,940<br>(48,540ha) | 30 | 173,700 | 258,970 | 0.4 cfs people @ each connection point to Detroit system | 14 | | |
| Southeast Oakland County Sanitary District | 21,480<br>(8690ha) | 20,480<br>(8290ha) | 46,870<br>(19,970ha) | 222,480 | 126,580 | 348,700 | 278 cfs ($8m^3/s$) | | Seven Mile Relief Sewer | In-line storage (100 acre-ft) 190 acre-ft retention basin. Excess overflows are skimmed and flow to the open channel of the Red Run Drain. |

## SUBURBAN WASTEWATER DISTRICTS SERVING MULTIPLE COMMUNITIES "continued"

| Sanitary District | Area in Acres | | | Population | | | Maximum Allowable Flow | No. of Metering Points | Major Interceptor Used | Overflows |
|---|---|---|---|---|---|---|---|---|---|---|
| | Combined | Separate | Total | Combined | Separate | Total | | | | |
| linton-Oakland anitary District | | 44,550<br>(18,030 ha) | 146,430<br>(59,260ha) | --- | 84,600 | --- | | | Oakland-Macomb Interceptor | |
| Evergreen-Farmington Sanitary District | 5870<br>(2380ha) | 46,490<br>(18,810ha) | 86,250<br>(34,900ha) | 32,450 | 171,550 | 255,000 | | 1 | Southfield Sewer | To the Rouge River via 1 outfall directly and 2 outfalls via 8 Mile Rd Drain. |

# APPENDIX 11.7

## Suburban Wastewater Treatment Facilities

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Suburban Wastewater Treatment Facilities

| Name of Community | Location of Facilities | Capacity and Type of Treatment | Receiving Stream | Remarks |
|---|---|---|---|---|
| 1. Village of Armada | South of the Grand Trunk R.R. on the East Branch of Coon Creek near North Road. | 0.15 mgd (560 $m^3/d$) Trickling filter secondary treatment. | East Branch of the Coon Creek, a tributary of the Clinton River. | Expand and upgrade. |
| 2. Chesterfield Township | Southern portion of township, below 21 Mile Road off of I-94. | Stabilization lagoon and DWSD System. | Lake Shore Interceptor | Will continue to discharge its effluent into DWSD System. |
| 3. City of Memphis | St. Clair County on the Belle River. | 0.2 mgd (760 $m^3/d$) Stabilization lagoons | Belle River | No definite plan of action for wastewater treatment, yet. |
| 4. City of Mount Clemens | East end of the City near the Clinton River. | 3.0 mgd (11,400 $m^3/d$) Trickling filter secondary treatment. | Clinton River | Currently constructing combined sewers and retention basin and treatment facility. |
| 5. City of New Baltimore | Near 23 Mile Road and Carpaud Creek. | 0.75 mgd (2800 $m^3/d$) Trickling filter secondary treatment. | Anchor Bay in Lake St. Clair | Will rebuild, upgrade, and expand to 1.75 mgd (6624 $m^3/d$) |
| 6. Village of New Haven | On the Salt River near 26 Mile Road | 0.18 mgd (680 $m^3/d$) Trickling filter secondary treatment. | Lake St. Clair via the Salt River | Village must make a decision on a program of pollution control. It is felt that the extension of a regional interceptor is not feasible before the year 2000. |
| 7. City of Pontiac | Both plants on the Clinton River in eastern portion of the City. | Two activated sludge plants with a combined capacity of 25.5 mgd (96,500 $m^3/d$) | Clinton River | Improvements completed in 1976. No plans to join the DWSD system. |

Suburban Wastewater Treatment Facilities
"continued"

| Name of Community | Location of Facilities | Capacity and Type of Treatment | Receiving Stream | Remarks |
|---|---|---|---|---|
| 8. City of Richmond | Near Hart Road and Forest. | 0.50 mgd (1892 $m^3/d$) Trickling filter secondary treatment. | Branch of the Salt River | Additional treatment is necessary to meet the NPDES permit. Extension of a regional interceptor does not seem feasible. |
| 9. City of Rochester | Southeastern boundary of the City. | 2.0 mgd (7570 $m^3/d$) Activated sludge plant. | Clinton River | The City has available capacity in the Oakland Arm of the Oakland-Macomb Interceptor System if it wants it. It has been recommended that the City make necessary improvements and utilize its own facilities. |
| 10. Village of Romeo | On 32 Mile Road near Powell. | 0.6 mgd (2271 $m^3/d$) Trickling filter secondary treatment. | East Pond Creek | Will rebuild and modernize existing facilities. |
| 11. City of Warren | On Red Run Drain near 14 Mile Road. | 36 mgd (136,260 $m^3/d$) Activated sludge plant and third stage treatment. | Red Run Drain, a branch of the Clinton River. | will continue expansion and modification program. No plans to join DWSD system. |

## APPENDIX 11.8

## Consent Judgment

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11-51

IN THE UNITED STATES DISTRICT COURT
FOR THE EASTERN DISTRICT OF MICHIGAN

THE UNITED STATES OF AMERICA,

Plaintiff and
Counter-Defendant,

v.

STATE OF MICHIGAN

Defendant and
Counter-Plaintiff
and Cross-Plaintiff,

v.

THE CITY OF DETROIT, a
municipal corporation,
THE DETROIT WATER AND SEWERAGE
DEPARTMENT,

Defendant and
Cross-Defendants

v.

All Communities and Agencies Under
Contract With The City of Detroit
For Sewage Treatment Services.

SEP 14 2 45 PM '77
CLERK

## CONSENT JUDGMENT

The above captioned Complaint having been filed herein, and with plaintiff and defendants by their respective attorneys having consented without trial or adjudication of any issue of fact or law herein to the entry of this Judgment, and without this Judgment constituting any evidence or admission by any party hereto with respect to any issue of fact or law herein; and,

The parties having acknowledged that the Federal Water Pollution Control Act, as amended in 1972 (FWPCA), 33 U.S.C. Sec. 1251 _et_. _seq_., prescribed a date of July 1, 1977, for the achievement of full secondary treatment; and,

The parties having acknowledged that jurisdiction is vested in this Court pursuant to the provisions of Section 309 of the FWPCA, 33 U.S.C. Sec. 1319(b) and 28 U.S.C. Sec. 1345; and,

The parties, in order to avoid the expense, further delays and uncertainties of protracted litigation, desire to establish a compliance schedule to achieve secondary treatment in the shortest reasonable period of time after July 1,1977; and, The parties having stipulated and agreed that the provisions of this Consent Judgment shall apply to and be binding upon all parties herein, jointly and severally, and to each of their agents and successors; and,

The United States Environmental Protection Agency (hereinafter U.S. EPA) and the Michigan Department of Natural Resources (hereinafter MDNR), having shown and expressed their desire to cooperate fully with the City of Detroit (hereinafter Detroit) in carrying out the provisions of this Judgment; hereby affirm and state that they will, to the extent possible under law, so cooperate; and

The parties recognize that National Pollutant Discharge Elimination System (NPDES) Permit No. MI 0022802 expired on July 1, 1977 and Michigan Water Resources Commission Final Order No. 1780 are hereby superseded. The State agrees that before the completion of the requirement or requirements of this Consent Judgment, a NPDES permit shall be issued to Detroit for all flows from sewage treatment plants operating in Detroit and,

The parties recognize that as a result of State, Federal, and International Studies, the phosphorus limitation expressed in this Consent Judgment may not be final and may be subject to revision by the parties and the Court following completion of these studies.

The parties shall comply with all present and future applicable state and federal laws, rules and regulations which include, but are not limited to: Michigan Act 245 of 1929 as amended being MCL 323.1; Michigan Act No. 98 of 1913 as amended being MCL 325.201; Michigan Act No. 348 of 1965, as amended, being MCL 336.11; the Revenue Bond Act of 1933 being MCL 141.101; Federal Water Pollution Control Act as amended being 33 U.S.C. Sec. 1250; Federal Air Pollution Control Act, as amended, being 42 U.S.C. Sec. 1857; and Title 40 of the Code of Federal Regulation.

The parties, recognizing the goals of the National Policy on Energy as stated by the President of the United States, agree that in execution and enforcement of this Judgment, such goals shall be considered, and that compliance with the terms of this Judgment shall be achieved in such manner as to promote maximum energy conservation; and, The parties recognize the need to provide sufficient immediate revenues and a continuing revenue system to properly manage, operate, maintain, control, supervise, test, staff, train, design, construct, finance, renovate, replace, repair, equip, control industrial wastes in an efficient, economic and cost effective manner, and to meet the local capital cost share for matching funds for construction grants by the U.S. EPA and the state of Michigan, for the treatment works serving the treatment jurisdiction, and therefore, that an immediate fair and reasonable sewage rate increase appears necessary; and

The parties having further stipulated that the following definition of terms as used in this Consent Judgment shall be:

A. The term "Industrial Cost Recovery System" shall mean,
A system of payment by industrial users of the treatment plant commensurate with Section 1284(b)(1)(B) of Title 33 of the United States Code and any regulations promulgated thereunder, as such statutory and regulatory provisions are currently in effect or as they may from time to time be amended.

B. The term "User Charge System" shall mean,
A system of payment for wastewater treatment at the treatment plant by those receiving the benefit of such treatment and which system is commensurate with Section 1284(b)(1)(A) of Title 33 of the United States Code and any regulations promulgated thereunder as such statutory and regulatory provisions are currently in effect or as they may from time to time be amended.

C. The term "Local Capital Cost Funding System" shall mean,
A system of borrowing principal and amortizing resultant debt service charges for local capital construction costs associated with existing and/or future wastewater treatment works projects.

D. The term "treatment jurisdiction" shall mean,
The geographical area including all municipalities and other political

jurisdictions of any kind, in which sewage disposal services of the Detroit are rendered and received.

E. The term "treatment works" shall mean,
Any devices and systems used in the storage, treatment, recycling, and reclamation of municipal sewage or industrial wastewater, which enters the Detroit sewerage system within the treatment jurisdiction including but not limited to the treatment plant, interceptors, and their appurtenances.

F. The term "treatment plant" shall mean,
The wastewater treatment facility located at 9300 West Jefferson Avenue, Detroit, Michigan.

G. The term "effluent" shall mean,
The aqueous discharge from the treatment plant.

H. The term "load" shall mean,
The total influent or effluent by weight of a specified pollutant characteristic which enters or leaves the treatment plant for one 24-hour day.

I. The term "sludge" shall mean,
An aqueous solution and/or suspension of solid material such as silt, organic matter and inorganic solids which results from the gravity settling processes,' and, which may be further concentrated to produce a material suitable for final disposal.

J. The term "interim sludge disposal" shall mean,
A procedure for the off-site disposal of all sludge generated by the treatment plant which can not be processed by existing on-site sludge disposal facilities until permanent sludge disposal facilities become operational.

K. The term "permanent sludge disposal" shall mean,
A procedure for the on-site reduction of all sludge generated by

the treatment plant unless an off-site alternative is approved as a permanent procedure for sludge disposal and the off-site disposal of ash or other residue.

L. The term "secondary treatment" shall have the same meaning as found in Section 133.102 of Title 40 of the Code of Federal Regulations.

M. The term "Facilities Plan" shall mean,
A written document prepared pursuant to U.S. EPA Construction Grant No. C262920-01 and the content requirements of 40 C.F.R. 35.917, which sets forth criteria for the upgrading and/or expansion of the treatment works such that said works can provide to all received wastewater, the level of treatment defined as secondary treatment plus removal of phosphorus from received wastewater as required, disposal of wastewater sludge as required, and other quality requirements.

N. The term "Operation and Maintenance Manual" shall mean,
A detailed document containing all information necessary for effective operation and maintenance of all equipment used in any wastewater treatment processes in the treatment works, and which meets the requirements of U.S. EPA publication EPA 430/9-74-001, "Considerations for Preparation of Operation and Maintenance Manuals."

O. The term "Implement" shall mean, to begin action or procedure to ensure the fulfillment of the program element.

NOW, THEREFORE, upon reading and filing the attached Complaint and in consideration of the foregoing and before the taking of any testimony, upon the pleadings, and without adjudication of any issue of fact or law herein and upon consent of the parties hereto to perform their respective responsibilities for the control of water pollution and the mitigation of impacts upon the quality of streams and lakes, air and land, and the Court being fully advised in the premises, it is Ordered, Adjudged and Decreed as follows:

I

## IMMEDIATE FINANCING, USER CHARGE, INDUSTRIAL COST RECOVERY AND LOCAL CAPITAL COST FUNDING SYSTEMS

### A. Immediate Financing

1. Detroit has agreed and did procure the services of a rate consulting firm to prepare a sewage rate determination on July 1, 1977, for the immediate financing needs of the treatment works. The Detroit Water and Sewerage Department did recommend the adoption of the above rate schedule to the Board of Water Commissioners and the Detroit City Council.

2. The Board and Council adopted rates necessary to meet the immediate financing needs of the treatment works; such rates being effective on all billings on and after September 1, 1977, for sewage disposal services rendered to all users of the treatment works.

### B. Continuing Revenue System and Sewer Use Ordinance

Detroit shall develop and enact a Sewer Use Ordinance, a User Charge System, an Industrial Cost Recovery System, and a Local Capital Cost Funding System to provide revenue necessary to meet the terms of this Judgment, and to provide secondary sewage treatment as required by law in accordance with the following:

1. On June 3, 1977, Detroit did prepare and present for approval to the U.S. EPA, Region V and the MDNR, a detailed description of its proposed sewer User Charge System, Industrial Cost Recovery System and Local Capital Cost Funding System including but not limited to budgets, cost allocations, user classifications, revenue projections, Industrial Cost Recovery methods, draft ordinances for Sewer Use, User Charges, Industrial Cost Recovery, and Local Capital Cost Funding, and projected alterations to existing service contracts.

2. On or before December 15, 1977, Detroit shall enter into an agreement with a rate study consultant to develop the User Charge System, Industrial Cost Recovery System, and Local Capital Cost Funding System as required by law and issue notice to the consultant to proceed with the work.

3. On or before June 1, 1978, Detroit shall submit a report to the U.S. EPA, Region V and MDNR describing in detail the progress to date on the development of the Sewer Use Ordinance, User Charge System, Industrial Cost Recovery System and Local Capital Cost Funding System such report to include, but not to be limited to any interim outputs sumbitted to Detroit by the rate study consultant.

4. On or before January 1, 1979, Detroit shall submit a report to the U.S. EPA, Region V and the MDNR describing in detail the progress to date on the development of the Sewer Use Ordinance, User Charge System, Industrial Cost Recovery System, and Local Capital Cost Funding System, such report to include, but not to be limited to any interim outputs submitted to Detroit by the rate study consultant.

5. On or before May 1, 1979, Detroit shall complete the proposed Sewer Use Ordinance, User Charge System, Industrial Cost Recovery System and Local Capital Cost Funding System and submit the rate study consultant's report and recommendations to the Detroit Board of Water Commissioners. Submit same to the Detroit City Council on or before July 1, 1979, for their action.

6. On or before September 1, 1979, Detroit shall complete all City Council actions for the implementation of the User Charge System, Industrial Cost Recovery System, and Local Capital Cost Funding System and for the enactment of the recommended ordinance for the regulation of sewer use.

7. On or before January 1, 1980, the User Charge System, Industrial Cost Recovery System and Local Capital Cost Funding System shall

become effective on all bills rendered in accordance therewith, except that, the Industrial Cost Recovery System shall be retroactive to the time that a construction grant project became operable.

## II

## INDUSTRIAL WASTE CONTROL

To minimize the discharge of pollutants into the treatment works which may interfere with, pass through or be incompatable with the operation of the treatment plant, Detroit shall implement the following program.

A. On August 19, 1977, Detroit did submit to the MDNR for approval, and shared wit the master contract agencies and the municipalities within the treatment jurisdiction whose approval is not required, a preliminary plan for Industrial Waste Control, describing a proposed program for the enforcement of Ordinance No. 129-H, Chapter 56, Article 6 of the Code of the City of Detroit; such plan to include but not be limited to personnel and equipment needs.

B. On or before January 1, 1978, Detroit shall submit to the U.S. EPA, and and the MDNR and obtain the approval of the MDNR, a plan which details the Detroit's program for the enforcement of the Detroit ordinance number 129-H, Chapter 56, Article 6.

C. On or before March 1, 1978, Detroit shall begin implementation of the approved enforcement program.

D. On or before August 1, 1978, Detroit shall place the aforementioned approved plan in full effect.

E. On or before January 1, 1979, and each January 1, thereafter, Detroit shall submit to the U.S. EPA and the MDNR,

  1. A management report summarizing the actions taken and the program results obtained pursuant to subsection (D) above,

including but not limited to; regulatory actions taken, implementation problems and corrective action.

2. A detailed report describing the staff retained to carry out the required pretreatment program; such report to include but not to be limited to staff duties and functions.

## III

## STAFFING, TRAINING, OPERATION AND MAINTENANCE

Detroit shall undertake and complete the following staffing, training, and operation and maintenance programs.

### A. Staff Procurement

1. On July 5, 1977, a staffing program was submitted to the MDNR for their approval detailing the manpower needs for Detroit to operate and maintain the existing treatment works. Said program included a schedule for the procurement of any additional manpower identified in the aforementioned program. This program has been approved by the U.S. EPA and is being reviewed by the MDNR to insure that it is in accordance with 40 C.F.R. 35.935-12 and page VI-35 of EPA's Handbook of Procedures.

2. Detroit shall proceed with the skilled maintenance work as provided under Contract No. PC-414 as was commenced on April 4, 1977. If prior to the completion of Contract PC-414 a full complement of permanent skilled maintenance personnel has not been obtained and trained, then a contract similar to PC-414 shall be awarded for performing the additional required maintenance. Such contract and subsequent similar contracts shall be issued until a full complement of permanent skilled maintenance personnel has been obtained and trained.

3. On or before October 1, 1977, Detroit shall implement the aforementioned approved staffing program.

4. On or before July 1, 1978, Detroit shall procure and maintain all personnel required to operate and maintain the existing treatment plant in accordance with the aforementioned approved program.

5. Detroit shall review and update the approved staffing program annually and beginning on September 1, 1978, and each September 1 thereafter submit an updated staffing program, in accordance with Section A(1) above, to MDNR and obtain the approval thereof.

6. Any material deviations from an approved staffing program shall be immediately reported in writing to the MDNR.

## B. Staff Training

1. On August 31, 1977, Detroit did submit to the MDNR and requested the approval thereof, a schedule for the training of personnel in accordance with Section B(2) below. Said schedule shall include all existing treatment works personnel and all new personnel hired after the implementation of this program.

2. On or before October 1, 1977, Detroit shall begin the training program developed by Detroit's Operation and Maintenance Manual contractor.

3. On or before November 1, 1978, Detroit shall submit to the MDNR and obtain the approval thereof, a continuing training program.

4. On or before April 1, 1979, Detroit shall place the aforementioned approved continuing training program into full effect for treatment plant and collecting system operation and maintenance personnel.

## C. Operation and Maintenance Manual

On or before October 1, 1978, Detroit shall complete an Operation and Maintenance Manual under contract CS-803 in accordance with 40 CFR 35.935-12.

D. Treatment Plant Maintenance and Repair

1. On or before April 1, 1978, the following maintenance and repair items shall be performed at the treatment plant utilizing contract maintenance personnel and/or permanent treatment plant maintenance staff.

    a. Repair and maintain all vacuum filters including but not limited to drive systems, control systems, and inlet valves. Install systems to insure that an adequate supply of wash water will be available for use in filter operation.

    b. Repair and maintain all incinerators including but not limited to repair of drive systems, control systems, auxiliaries, induced draft fans, and wet ash disposal backup systems. Restore the stack gas oxygen concentration monitoring systems.

    c. Repair and maintain the Oakwood, Jefferson and Zug Island sampling systems; collect manual composite samples at these locations whenever any of these three compositors fail to operate as required, provided the sampling pumps remain in operation. Spare pumps and compositors shall be available prior to June 1, 1979, for rapid installation.

2. Primary rectangular and circular settling tanks at the treatment plant shall be rehabilitated in accordance with the following schedule. No more than two primary clarifiers may be out of service at any one time for rehabilitation.

    a. Four rectangular clarifiers rehabilitated on or before September 23, 1978.

b. Four additional rectangular clarifiers rehabilitated on or before August 31, 1979

*c. Final four rectangular clarifiers and the two circular primary clarifiers rehabilitated on or before August 31, 1980.

*d. After August 31, 1980, one clarifier shall be removed from service every eight months and maintained or repaired as required to prevent future failure and promote maximum efficiency.

3. Sludge Conveyor System Maintenance:

a. Detroit shall on a regular and frequent basis inspect all sludge conveyor drives, belts and rollers and lubricate as required to assure proper operation.

b. On or before January 1, 1978, submit a preliminary engineering report and basis for design identifying all locations and components where access to equipment and/or current lubrication systems are inadequate for inspection, operation and maintenance of the sludge conveyor systems to the MDNR and obtain the approval thereof. Said report will include the basis of design for the correction of all identified inadequacies.

i. Complete design of the items identified in the report above on or before April 1, 1978.

ii. Begin construction on or before October 1, 1978.

iii. Complete construction and begin operation on or before June 1, 1979.

4. On or before July 1, 1978, renovate and/or install and begin and maintain the operation of flow monitoring equipment necessary to measure and record the quantity of the plant effluent.

* See Segmented Facilities Plan Requirements

5. Detroit shall on a regular and frequent basis, remove scum and clean the effluent wiers on all primary and final clarifiers that are in service at the treatment plant to assure maximum clarifier efficiency.

6. Repair and maintain on a continuing basis such other equipment at the treatment plant which is necessary to maintain maximum operational efficiency in pollution control.

E. Procurement

On June 30, 1977, Detroit did prepare and submit a procurement plan to the MDNR. This procurement plan describes procedures and authority and responsibility necessary for procurements required to meet the terms of this Consent Judgment and to provide secondary treatment, phosphorus removal and other air and water pollution controls that are required by law. The plan did consider the procurement of supplies, equipment, materials, skilled maintenance services consulting services, and the processing of purchase requistions and construction contracts. On or before September 30, 1977, Detroit shall identify procedures available to Detroit to procure materials and services on an accelerated basis when needed or to make advance preparation for such need.

F. Final Clarifiers

The final clarifiers were tentatively designed to operate at an average rate of 50 million gallons per day of mixed liquor, resulting in an overflow rate of 1,600 gallons per day per square foot, and a detention time of 1.92 hours. Since phosphorus, BOD and phenols in the secondary effluent are directly related to the suspended solids level contained in the effluent, improvement in the settling and thickening processes of the clarifier is required for a reduction of the suspended solids in the effluent. A program to upgrade the performance of the final clarifiers to remove suspended solids and thickening of return sludge at a satisfactory level shall be undertaken as follows:

1. On August 12, 1977, Detroit submitted a report detailing which clarifier will be used as the test unit and

testing program to the MDNR for their approval.

2. On or before October 10, 1977, Detroit shall obtain the material and manpower and shall modify the inlet piping of the test clarifier on or before November 30, 1977.

3. On or before March 15, 1978, Detroit shall perform a series of tests under various loading and water temperature conditions to determine optimum clarifier performance.

4. On or before April 15, 1978, Detroit shall prepare a report of the test results together with recommendations for revision and/or modification of the remaining final clarifiers or on the need to further modify the prototype tank to obtain optimum clarifier performance.

5. On or before May 1, 1978, if the inlet piping modification is successful, Detroit shall file a grant application for revisions and/or modifications to remaining clarifiers.

6. If design revisions or modifications of existing clarifiers are required, or more than 25 final clairifiers are needed for satisfactory operation, Detroit shall submit to the U.S. EPA, Region V and the MDNR a schedule on or before May 30, 1978, for such revisions, modifications, or additions which, after approval by all parties herein and by this Court, will be made fully enforceable as a part of this Judgment.

## IV

## FACILITIES PLAN

### A. Segmented Facilities Plan

Detroit shall submit and obtain approval of MDNR and U.S. EPA of a "Segmented Facilities Plan" on or before May 15, 1978, and accomplish the following progress tasks pursuant to completion of said Plan:

1. Amend existing consultant agreements on or before September 30, 1977.

2. Resolve between the parties the following issues on or before December 31, 1977: plant site, West Arm interceptor, permanent sludge disposal program and air quality control.

3. Prepare a combined sewer overflow sampling schedule on or before December 31, 1977, for use as guidance in developing a work plan for Section B, below.

4. Prepare, publish and distribute a segmented Facilities Plan with an environmental assessment on or before January 31, 1978.

## B. Final Facilities Plan

1. Detroit shall select and retain a consultant to prepare a final facilities plan on or before December 31, 1977.

2. Detroit shall submit to MDNR and U.S. EPA, on or before February 29, 1980, interim reports which include but need not be limited to:

   a. Establishing the quantity and quality of combined sewer overflows within the service area.

   b. Calibrating the precise capibility and capacity of the then existing plant.

   c. Establishing the total influent flow and characteristics from both combined and sanitary sewers.

   d. Identifying and describing the facilities required at the existing treatment plant or any other identified site to treat combined sewer overflows as well as dry weather flows.

   e. Developing a time schedule and cost estimates for the work to be performed within the planning period.

f. Providing an implementable site plan for all facilities required during the planning period.

g. Describing all outfall requirements and limitations for each treatment facility.

h. Resolving any and all air quality standard attainment issues associate with ultimate sludge disposal.

i. Preparing an environmental assessment for all facilities and sites.

3. Submit a final facilities plan which provides solutions and recommendations for all necessary wastewater treatment facilities on or before March 31, 1981.

## V

## SLUDGE DISPOSAL

Detroit shall dispose of or provide for the disposal of sludge generated from treatment of sewage at the treatment plant in accordance with the following schedule:

A. Interim Sludge Disposal:

1. On or before October 1, 1977, submit an interim sludge disposal report to the MDNR and the U.S. EPA, and obtain approval of said plan from the MDNR. Said report must include but need not be limited to:

a. A description of each interim sludge disposal alternative considered by Detroit.

b. The feasibility of each alternative with respect to maximum efficiency, effectiveness and environmental compatibility of interim sludge disposal.

c. The cost of each alternative.

d. A quantification of the ability of each alternative to process increasingly larger amounts of sludge as additional treatment facilities become operational at the treatment plant.

e. Identification of the alternative which is proposed for implementation.

2. On or before January 15, 1978, submit final plans for interim sludge disposal to the MDNR and obtain approval thereof. Said final plans will include but need not be limited to disposal location, hydrogeology, rates, process and method of conveyance of sludge to disposal site.

3. Award a contract for interim sludge displosal on or before March 1, 1978.

4. Begin interim sludge disposal on or before April 1, 1978.

B. Permanent Sludge Disposal

1. Detroit shall select a permanent sludge disposal program in accordance with the Segmented Facilities Plan, and submit a request for approval of such program to the MDNR.

2. If the alternative chosen pursuant to paragraph (1) of this subsection is the program for construction of Sludge Complex III currently planned under Detroit public contract designated as PC 295 (hereinafter PC 295), construction shall be completed and operation shall begin on or before September 1, 1981.

3. If pursuant to paragraph (1) of this subsection, PC 295 is modified in concept or capacity or an alternative sludge disposal method is selected as the permanent method of sludge disposal at the treatment plant, construction shall be completed no later December 1, 1983, in accordance with the requirements set forth in the Segmented Facilities Plan.

## VI

## SECONDARY TREATMENT

Detroit shall provide complete secondary sewage treatment at the treatment plant in accordance with the following schedule, plus any additional requirements necessary to attain complete secondary treatment. The effective capacity for secondary treatment shall be increased to 1,050 MGD on or before September 1, 1980.

A. Detroit completed construction pursuant to Detroit public contract designated as PC 284 (hereinafter PC 284) of four final clarifiers, on June 24, 1977. Detroit shall assure operational capability of these clarifiers on or before December 1, 1977.

B. Detroit completed construction pursuant to Detroit public contract designated as PC 283 (hereinafter PC 283) of aeration basins three and four on July 15, 1977. Detroit shall assure operational capability of these aeration basins on or before December 1, 1977.

C. Detroit shall redesign piping structures on four final clarifiers pursuant to Detroit public contract designated as PC 285 (hereinafter PC 285) in accordance with the schedule set forth in Section III, subsection F of this Judgment on or before May 1, 1978.

D. Detroit shall complete construction pursuant to Detroit public contract designated as PC 406A of four final clarifiers on or before June 2, 1978. Detroit shall assure operational capability of these clarifiers on or before December 1, 1978.

E. Detroit shall complete construction, pursuant to Detroit public contract designated as PC 408 (hereinafter PC 408) of four final clarifiers on or before February 28, 1979. Detroit shall assure operational capability of these clarifiers on or before September 1, 1979.

F. Detroit shall complete construction pursuant to Detroit public contract designated as PC 288A (hereinafter PC 288A) of an oxygen plant, on or before July 18, 1979. Detroit shall place this unit into operation, on or before, December 30, 1979.

* G. Detroit shall complete construction of two primary clarifiers pursuant to PC 276 on or before July 15, 1980.

* H. Detroit shall complete construction of four final clarifiers pursuant to PC 285 on or before December 1, 1980.

I. On or before September 1, 1980, all flows of effluent from the treatment plant shall have received secondary treatment.

## VII

## PHOSPHORUS REMOVAL

Detroit shall achieve the phosphorus effluent concentration limitation in accordance with the requirements set forth in the Segmented Facilities Plan in the following schedul for design and construction of a phosphorus removal system at the treatment plant:

A. Construction target dates

1. Begin design on or before January 1, 1978.
2. Complete design on or before February 1, 1979.
3. Begin construction on or before September 1, 1979.
4. Complete construction and begin operation on or before September 1, 1981.

B. Detroit shall achieve and maintain a concentration of total phosphorus in the treatment plant effluent no greater than one milligram per liter on or before April 1, 1982.

* Subject to Segmented Facilities Plan requirements.

## VIII

## EFFLUENT LIMITATIONS

Effluent discharges from Detroit outfalls 049 and 050 of the treatment plant shall be limited as follows:

A. Beginning on the effective date of this Judgment and lasting until June 30, 1978.

| Effluent Characteristic | Discharge Load Limitations lb/day | | Discharge Concentration Limitations mg/l | |
|---|---|---|---|---|
| | 30-Day Avg. | 7-Day Avg. | 30-Day Avg. | 7-Day Avg. |
| BOD5 | 650,000 | 975,000 | 87 | 130 |
| Total Suspended Solids | 1,200,000 | 1,800,000 | 160 | 240 |
| Phenol | 1,900 | 2,300 | 0.25 | 0.3 |
| Oil & Grease | - | - | - | 45 |
| Total Phosphorus (as P) | - | - | 4.0 | - |
| Fecal Coliform | - | - | 200/100 ml | 400/100 ml |

pH 6.5 - 9.0 SU

B. Beginning on July 1, 1978 and lasting until December 30, 1979.

| Effluent Characteristic | Discharge Load Limitations lb/day | | Discharge Concentration Limitations mg/l | |
|---|---|---|---|---|
| | 30-Day Avg. | 7-Day Avg. | 30-Day Avg. | 7-Day Avg. |
| BOD5 | 525,000 | 788,000 | 70 | 105 |
| Total Suspended Solids | 826,000 | 1,280,000 | 110 | 170 |
| Phenol | 1,900 | 2,300 | 0.25 | 0.3 |
| Oil & Grease | - | - | - | 30 |
| Total Phosphorus (as P) | - | - | 4.0 | - |
| Fecal Coliform | - | - | 200/100 ml | 400/100 ml |

pH 6.5 - 9.0 SU

C. Beginning on December 31, 1979 and lasting until December 30, 1981.

| Effluent Characteristic | Discharge Load Limitations lb/day | | Discharge Concentration Limitations mg/l | |
|---|---|---|---|---|
| | 30-Day Avg. | 7-Day Avg. | 30-Day Avg. | 7-Day Avg. |
| BOD5 | 250,000 | 375,000 | 30 | 45 |
| Total Suspended Solids | 250,000 | 375,000 | 30 | 45 |
| Phenol | 850 | 1,700 | 0.1 | 0.2 |
| Oil & Grease | - | - | - | 15 |
| Total Phosphorus (as P) | - | - | 2.5 | - |
| Fecal Coliform | - | - | 200/100 ml | 400/100 ml |

pH 6.5 - 9.0 SU

D. Beginning on December 31, 1981 and lasting until the expiration date.

| Effluent Characteristic | Discharge Load Limitations lb/day | | Discharge Concentration Limitation mg/l | |
|---|---|---|---|---|
| | 30-Day Avg. | 7-Day Avg. | 30 Day Avg. | 7-Day Avg. |
| BOD5 | 263,000 | 394,000 | 30** | 45 |
| Total Suspended Solids | 263,000 | 394,000 | 30** | 45 |
| Phenol | 900 | 1,800 | 0.1 | 0.2 |
| Oil & Grease | - | - | - | 15 |
| Total Phosphorus (as P) | - | - | 1.0 | - |
| Fecal Coliform | - | - | 200/100 ml | 400/100 ml |

pH 6.5 - 9.0 SU

** The monthly average removal efficiency shall not be less than 85 percent.

The limitations herein are premised on the following projected maximum daily flows averaged over a 30 day period.

| | |
|---|---|
| From present to June 30, 1978 | 900 MGD |
| From July 1, 1978 to December 30, 1979 | 900 MGD |
| From December 31, 1979 to December 30, 1981 | 1,000 MGD |
| From December 31, 1981 to Future | 1,050 MGD |

The aforementioned flows as well as flows to be reported under the terms and conditions of this Consent Judgment are the actual effluent flows as nearly as can be determined from adjusted readings based on test information and related data. Such flow consists of combined flow received into the plant which includes sanitary, industrial, infiltration inflow and storm flow but excludes flow recycled within the plant and evaporation losses. Such effluent flow also includes the potable water received into the plant.

## IX

## REPORTING

A. Beginning October 1, 1977, and every three months thereafter, Detroit shall submit to the U.S. EPA and the MDNR a report detailing the up-to-date status and/or progress on all programs or projects ordered in this Judgment, including but not limited to identification of any items that might affect scheduled completion. A projection of the work to be performed under the terms and conditions of this Consent Judgment during the subsequent twelve month period is to be included in each quarterly report.

B. A summary of the report described in subsection A of this section shall be submitted to each party herein and the full report shall be avialble for inspection by any party at the office of the Detroit Water and Sewerage Department.

C. In addition to the quarterly reports required in subsection A of this section, not later than fourteen calendar days following any date on which an action is required of Detroit by this Judgment, Detroit shall submit to the U.S. EPA and the MDNR, a written notice that the action has been taken or completed as required or that the action has not been taken or completed as required. If the action has not been taken or completed as required the notice shall include the reasons and/or causes for the inaction or failure to complete action, and the probability of meeting the next scheduled requirements. A statement shall be included which describes the actions to be taken or being taken to return the program element to the required schedule.

# X

## SPECIAL REQUIREMENTS

This section incorporates NPDES language to apply in lieu of a current NPDES permit until such new NPDES permit is issued.

### A. Monitoring and Reporting

1. Representative Sampling

Samples and measurements taken as required herein shall be representative of the volume and nature of the monitored discharge.

2. Reporting

Detroit shall submit monitoring reports containing results obtained during the previous month and shall be postmarked no later than the 10th day of the month following each completed report period.

3. Detroit shall perform the following sampling, analysis and program as their self-monitoring program. The pollutant characteristics, including industrial wastes, shall be monitored by collecting the indicated type of sample with the designated frequency. Except as listed otherwise in the table, each characteristic shall be reported for each major influent sewer and for each effluent sewer which transmits flow to the Detroit or Rouge Rivers.

| | Monitoring Requirements | | |
|---|---|---|---|
| Effluent Characteristic | Measurement Frequency | Sample Type & Location | Influent Sampling Not Required |
| 5-day 20 C Biochemical Oxygen Demand | 7 x/week | 24 Hr. Comp. | |
| Suspended Solids | 7 x/week | 24 Hr. Comp. | |
| Phenol | 7 x/week | 24 Hr. Comp. | |
| Oil | 7 x/week | 24 Hr. Comp. | |
| Fecal Coliform Bacteria | 1 x/shift | Grab, Averaged each day | |
| Total Phosphorus | 7 x/week | 24 Hr. Comp. | |
| Flow | 7 x/week | Daily Total flow | |
| pH | 7 x/week | Grab - No Averaging | |
| Cadmium | 1 x/week** | 24 Hr. Comp. | |
| Chloride | 3 x/week** | 24 Hr. Comp. | x |
| Chromium, Total | 1 x/week** | 24 Hr. Comp. | |
| Chromium, Hexavalent | 1 x/week** | 24 Hr. Comp. | |
| Copper | 1 x/week** | 24 Hr. Comp. | |

| | | | |
|---|---|---|---|
| Cyanide | 3 x/week** | 24 Hr. Comp. | |
| Iron | 1 x/shift | Report as daily average | |
| Lead | 7 x/week | 24 Hr. Comp. | |
| Nickel | 1 x/week** | 24 Hr. Comp. | |
| Zinc | 1 x/week** | 24 Hr. Comp. | |
| Aluminum | 1 x/week** | 24 Hr. Comp. | |
| Arsenic | 3 x/week** | 24 Hr. Comp. | |
| Mercury | 7 x/week | 24 Hr. Comp. | |
| Selenium | 1 x/week** | 24 Hr. Comp. | |
| Barium | 3 x/week** | 24 Hr. Comp. | |
| Calcium | 3 x/week** | 24 Hr. Comp. | x |
| Magnesium | 1 x/week** | 24 Hr. Comp. | x |
| Manganese | 1 x/week** | 24 Hr. Comp. | x |
| Sodium | 1 x/week** | 24 Hr. Comp. | x |
| Chlorine, Free | 1 x/shift | Grab - Report Daily Average | x |
| Chlorine, Combined | 7 x/week | Grab - Report Daily Average | x |
| Polychlorinated biphenols | | | |
| Arochlor 1242 | 1 x/week** | 24 Hr. Comp. | |
| Arochlor 1254 | 1 x/week** | 24 Hr. Comp. | |
| Arochlor 1260 | 1 x/week** | 24 Hr. Comp. | |
| Hexachlorobenzene | 1 x/week** | 24 Hr. Comp. | |
| Carbon tetrachloride | 1 x/week** | 24 Hr. Comp. | |
| Hexachlorocyclopentadiene | 1 x/week** | 24 Hr. Comp. | |
| Hexachlorobutadiene | 1 x/week** | 24 Hr. Comp. | |
| Pentachlorophenol | 1 x/week** | 24 Hr. Comp. | |
| Benzene | 1 x/week** | 24 Hr. Comp. | |
| Trichloroethylene | 1 x/week** | 24 Hr. Comp. | |
| Trichloroethene | 1 x/week** | 24 Hr. Comp. | |
| Trihalomethanes | 1 x/week** | 24 Hr. Comp. | |

** Randomly vary the days of the week on which the samples are collected.

4. Definitions.

a. The 30 consecutive day average other than for fecal or total coliform bacteria, is defined as the sum of the concentrations and/or weights of the individual samples divided by the number of samples taken during a 30-day period. When less than daily sampling is required, the 30-day average is defined as the sum of all the values recorded divided by the number of samples taken. The 30 consecutive day average for fecal or total coliform bacteria is the geometric mean of the samples collected in a 30-day period.

b. The 7 consecutive day average other than for fecal or total coliform bacteria, is defined as the sum of the concentrations and/or weights of the individual samples divided by the number of samples taken during a 7 day period. The 7 consecutive day average for fecal or total coliform bacteria is the geometric mean of the samples collected in a 7 day period.

c. The maximum limitation is defined as the permissible maximum concentration and/or weight in any individual sample taken during the month.

5. Test Procedures

Test procedures for the analysis of pollutants shall conform to regulations published pursuant to Section 304(g) of the Federal Water Pollution Control Act, under which such procedures may be required.

6. Recording of Results

For each measurement or sample taken pursuant to the requirements of this Judgment, Detroit shall record the following information:

a. The exact place, date, and time of sampling;

b. The dates the analyses were performed;

c. The person(s) who performed the analyses;

d. The analytical techniques or mentods used; and

e. The results of all required analyses.

7. Additional Monitoring by Detroit

If Detroit monitors any pollutant at the location(s) designated herein more frequently than required by this Judgment, using approved analytical methods as specified above, the results of such monitoring shall be included in the calculation and reporting of the values required in the Monthly Operating Report. Such increased frequency shall also be indicated.

8. Records Retention

All records and information resulting from the monitoring activities required by this Judgment including all records of analyses performed and calibration and maintenance of instrumentation and recordings from continous monitoring instrumentation shall be retained for a minimum of three (3) years, or longer if requested by the Regional Administrator, U.S. EPA or MDNR.

B. Management Requirements

1. Change in Discharge

All discharges authorized herein shall be consistent with the terms and conditions of this Judgment. The discharge of any pollutant identified in this Judgment more frequently than or at a level in excess of that authorized is prohibited. Any anticipated facility expansions, or process modifications which will result in new, different, or increased discharges of pollutants must be reported to MDNR, and U.S. EPA, Region V, if such changes will violate the effluent limitations specified in this Judgment.

2. Containment Facilities

Detroit shall provide approved facilities for containment of any accidental losses of concentrated solutions, acids, alkalies, salts, oils, or other polluting materials in accordance with the requirements of the Michigan Water Resources Commission Rules, Part 5.

3. Operator Certification

Detroit shall have the waste treatment facilities under the direct supervision of an operator certified by the MDNR, as required by Section 6a of MCL 323.201.

4. Spill Notification

Detroit shall immediately report any spill or loss of any product, by-product, intermediate product, oils, solvents, waste material, or any other polluting substance which occurs to the surface or groundwaters of the State by calling the MDNR 24-hour Emergency Response telephone number (517) 373-7660; and Detroit shall within ten (10) days of the spill or loss provide the MDNR with a full written explanation as to the cause and discovery of the spill or loss, clean up and recovery measures taken, preventative measures to be taken, and schedule of implementation.

5. Adverse Impact

Detroit shall minimize any adverse impact to navigable waters resulting from noncompliance with any effluent limitations specified in this Judgment, including such accelerated or additional monitoring as necessary to determine the nature and impact of the noncomplying discharge.

6. By-passing

Any diversion from or by-pass of facilities necessary to manitain compliance with the terms and conditions of this Judgment is prohibited, except (i) where unavoidable to prevent loss of life or severe property damage, or (ii) where excessive storm drainage or runoff would damage any facilities necessary for compliance with the effluent limitations and prohibitions of this Judgment. Detroit shall promptly notify MDNR and U.S. EPA, Region V, in writing, of such diversion or by-pass.

7. Removed Substances

Solids, sludges, filter backwash, or other pollutants removed from or resulting from treatment or control of wastewaters shall be disposed of in a manner such as to prevent any pollutant from such materials from entering navigable waters, or the entry of toxic or harmful contaminants thereof into the groundwaters in concentrations or amounts detrimental to the groundwater resource.

8. Power Failures

In order to maintain compliance with the effluent limitations and prohibitions of this Judgment, Detroit shall either:

a. Provide an alternative power source sufficient to operate facilities utilized by Detroit to maintain compliance with the effluent limitations and conditions of this Judgment which provision shall be indicated in this Judgment by inclusion of a specific compliance date in each appropriate "Schedule of Compliance for Effluent Limitations".

b. Upon the reduction, loss, or failure of one or more of the primary sources of power to facilities utilized by Detroit to maintain compliance with the effluent limitations and conditions of this Judgment, Detroit shall halt, reduce or otherwise control all discharge in order to maintain compliance with the effluent limitations and conditions of this Judgment.

C. Responsibilities

1. Right of Entry

Detroit shall allow the MDNR and U.S. EPA, Region V, and/or their authorized representatives, upon the presentation of the credentials:

a. To enter upon Detroit's premises where an effluent source is located or in which any records are required to be kept under the terms and conditions of this Judgment, and;

b. At reasonable times to have access to and copy any records required to be kept under the terms and conditions of this Judgment; to inspect any monitoring equipment or monitoring method required in this Judgment; and to sample any discharge of pollutants.

2. Transfer of Ownership or Control

In the event of any change in control or ownership of facilities from which the authorized discharge emanates , Detroit shall notify the succeeding owner or controller of the existence of this Judgment by letter, a copy of which shall be forwarded to the MDNR, U.S. EPA, Region V, and this Court.

3. Availability of Reports

Except for data determined to be confidential under Section 308 of the Federal Water Pollution Act and Rule 2128 of the Water Resources Commission Rules, Part 21, all reports prepared in accordance with the terms of this Judgment shall be available for public inspection at the offices of the MDNR and U.S. EPA, Region V. As required by the Act, effluent data shall not be considered confidential.

4. Notice to Public Utilities

It is further made a condition of this Judgment that Detroit give notice to the public utilities in accordance with Act 43 of the Public Acts of 1974, being MCL 460.701 to 460.718, and comply with each of the requirements of that Act.

D. Combined Sewer Overflows

The City of Detroit is required to continue its program for attainment of control of overflows from the combined sewer system discharge points number 001 through 048 and 501 through 080 (as identified in Detroit's application submitted to obtain NPDES Permit No. MI 0022802). The City shall operate the existing treatment facilities (including the combined sewer system and the treatment plant) in such a manner as to minimize the discharge of combined sewer overflows to the Detroit River, the Rouge River and their tributaries. The City shall maximize utilization of all available in-system storage for retention of combined wastewater.

## XI

## STATE APPROVAL

Plans for all construction projects Detroit undertakes pursuant to the Judgment must receive approval from the MDNR. In addition all federal construction grant projects must be certified by the MDNR pursuant to 33 U.S.C. 1284(a)(3) and submitted to the U.S. EPA for approval.

## XII

## CUSTOMER RELATIONS

Detroit shall establish in the Detroit Water and Sewerage Department an Office of Customer Relations which shall maintain improved relations between the Detroit Water and Sewerage Department and its City and Suburban customers. The Office of Customer Relations shall also serve as a clearinghouse for customers' input for improved service.

## XIII

## FINANCIAL AUDIT

Detroit shall provide that a financial audit of the Detroit Water and Sewerage Department be conducted by a major private sector accounting firm not less than every twelve months. Such audits shall be made available to the parties herein as shall be any other financial audits operation routinely conducted at the Detroit Water and Sewerage Department. Such audits shall continue throughout the term of this Consent Judgment.

## XIV

## LIQUIDATED DAMAGES AND CIVIL PENALTIES

The parties are unable to reach agreement on the measures of civil penalties and liquidated damages, if any, and, being unable to reach agreement, submit to the Court for determination of these issues.

## XV

## NONCOMPLIANCE EXCUSED FOR CAUSE

Should Acts of God or contract related events occur over which Detroit has no control, Detroit shall immediately notify the MDNR and the Regional Administrator of the U.S. EPA, Region V, in writing of the delay or anticipated delay, describing in detail the anticipated length of delay, the precise cause or causes of the delay, the measures taken and to be taken by Detroit to prevent or minimize the delay, and the timetable by which the measures shall be implemented. The Regional Administrator, U.S. EPA, Region V, and MDNR shall make a determination if any schedule in this Consent Judgment will be revised based on the information submitted by Detroit. If Detroit is in disagreement with the decision of the Regional Administratorand MDNR, its recourse is before this Court.

## XVI

## CAUSE FOR HEARING

Any failure to comply with any terms of this Judgment shall be cause for any party to request the Court to place the case on the calendar for hearing on the merits.

## XVII

## AMENDABILITY

Any party may apply to this Court for such further orders and directions as may be appropriate.

IT IS SO ORDERED

The following parties do hereby consent:

CITY OF DETROIT

BY ______________________________
COLEMAN A. YOUNG, Mayor

BY Darryl F. Alexander
FOR ROGER E. CRAIG, Corporation Counsel

CITY OF DETROIT
CITY COUNCIL

BY ______________________________
City Council President

CITY OF DETROIT
BOARD OF WATER COMMISSIONERS

BY ______________________________
JOHN P. KANTERS - Director

STATE OF MICHIGAN

BY ______________________________
For FRANK J. KELLEY, Attorney General

STATE OF MICHIGAN
MICHIGAN DEPT. OF NATURAL RESOURCES

BY ______________________________

UNITED STATES OF AMERICA

BY ______________________________
for JAMES ROBINSON, U.S. Attorney

U.S. ENVIRONMENTAL PROTECTION AGENCY

BY Sanford M. Stein
for GEORGE R. ALEXANDER, JR.
Regional Administrator

It is so Ordered:
Effective September 9, 1977
at 4:50 P.M

DATED: September 14, 1977

______________________________
HONORABLE FEDERAL COURT JUDGE

COUNTY OF OAKLAND, G. W. KUHN,
DRAIN COMMISSIONER, on behalf of
CLINTON-OAKLAND DISPOSAL SYSTEM,
EVERGREEN-FARMINGTON SEWAGE DISPOSAL
SYSTEM and SOUTHEAST OAKLAND SANITARY
DISPOSAL DISTRICT:

By: ______________________________
George W. Kuhn, Drain Commissioner

William P. Hampton
Attorney

Date:

# APPENDIX 11.9

## Letter of Intent

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UNITED STATES
ENVIRONMENTAL PROTECTION AGENCY
REGION V
230 SOUTH DEARBORN ST.
CHICAGO, ILLINOIS 60604

AUG 3 1976

TO ALL INTERESTED AGENCIES, PUBLIC GROUPS, AND CITIZENS:

In compliance with the National Environmental Policy Act, the Federal Water Pollution Control Act, as amended, and the Environmental Protection Agency's regulations for preparation of Environmental Impact Statements (EIS) as published in the Federal Register, April 14, 1975, the attached is a Notice of Intent to prepare an EIS for the proposed EPA action described below:

> Financial assistance for the design and construction of wastewater treatment facilities for The City of Detroit, Board of Water Commissioners.

EPA, Region V, has declared its intent to prepare an EIS on the subject project concurrently with the development of the Overview Plan which includes the facilities plans. The Board, in conjunction with EPA, will contract with two independent consultants to provide an Overview Plan and an EIS.

The public is invited to provide information and encouraged to participate in the development of the draft EIS. To this end, a series of public information meetings will be held in the project area at key stages in the development of the EIS. Further notification of meetings will be supplied at a later date.

Comments or requests for additional information should be directed to Gene Wojcik, Chief, EIS Preparation Section, at the above address.

In addition to the public information meetings, an official public hearing will be scheduled upon completion of the draft EIS to receive comments from concerned parties.

Sincerely yours,

George R. Alexander, Jr.
Regional Administrator

Attachment

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UNITED STATES
ENVIRONMENTAL PROTECTION AGENCY
REGION V
230 SOUTH DEARBORN ST.
CHICAGO, ILLINOIS 60604

AUG 3 1976

# Notice of Intent

## To Prepare an Environmental Impact Statement

U.S. Environmental Protection Agency
Region V

## I. Project Location

The project is the expansion of the City of Detroit Treatment Plant and interceptor facilities to serve the City of Detroit and neighboring communities in Wayne, Oakland, and Macomb Counties. These areas are drained by the Clinton River Basin and Rouge River Basin into Lake St. Clair and the Detroit River with the exception of the areas which drain directly into Lake St. Clair or the Detroit River.

## II. Purpose

The purpose of the expansion and improvements of the wastewater plant and interceptor collection system is to protect the water of Lake St. Clair, the Detroit River, and Lake Erie as well as inland streams of the Rouge River Basin and Clinton River Basin. Increased treatment capacity with upgrading to secondary treatment is required to meet the projected population growth in the Detroit area. New interceptors will relieve flows through combined sewers and provide additional instream storage capacity. Eight new sludge incinerators, designated as Sludge Complex III, will increase the existing incineration capacity by 640 dry tons per day (TPD) to a total of 1568 TPD. Additional work to be considered includes the separation of combined sewers to provide storm relief in several areas under study.

## III. Proposed EPA Action

The proposed action is Federal financial assistance for the design and construction of expanded wastewater treatment facilities, relief interceptors, and additional sludge disposal facilities for the City of Detroit. EPA has determined that the proposed project could significantly impact the human environment and, therefore, has decided to prepare an EIS. For more effective and timely use of the EIS as a planning and decision-making tool, EPA, The City of Detroit, Board of Water Commissioners, and the State of Michigan have entered into a "Memorandum of Understanding" which allows for the preparation of the EIS and the Overview Plan concurrently. Facilities planning tasks will be included in the Overview Plan.

## IV. Major Issues to be Evaluated

1) The development of relief interceptors designated as the Armada, Bruce, Richmond and Lake Shore Arms. In these areas secondary growth impacts will be generated by the increased flow capacities and instream storage capacities. New interceptors will provide flow capacities to allow one wastewater treatment plant to be phased out by the 1980's.

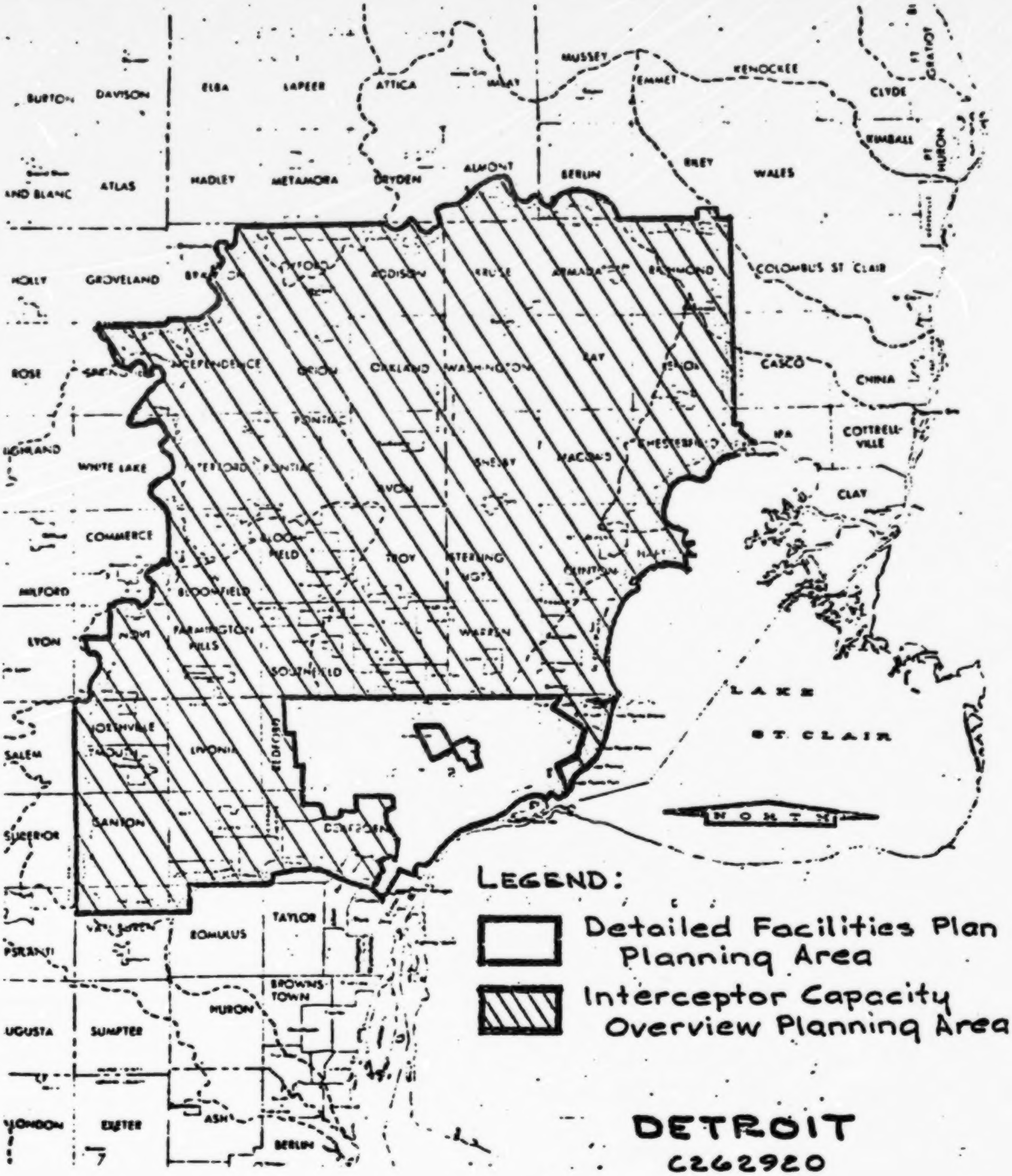
2) Detroit is a Air Quality Maintenance Area (AQMA). The impacts of the existing incinerators and those soon to be constructed have been documented. Discussions of the relationship of these twenty-two incinerators to the overall alternatives for future sludge disposal must be developed. The need for auxiliary fuels for sludge disposal must be addressed.

3) The development of new ash lagoons and ultimate disposal sites for fly and bottom ash should be addressed. Land disposal alternatives for sludge and sludge cake should be addressed. Techniques and monitoring systems for all disposal should be adequately outlined.

4) The acquisition of land for expansion of the treatment plant should be adequately addressed. Timetables and costs to purchase lands for wastewater treatment facilities at sites adjacent or removed from the existing site should be developed.

5) The time necessary to upgrade the plant to a secondary treatment facility with 80% phosphorous removal and BOD removal should be discussed in connection with increased flows and sewer separations.

6) All aspects of social growth within the plan of study area should be discussed. This includes, but is not limited to, economic growth, residential development, industrial and commerical development, strip development along new interceptors, political development in the suburban areas, and retirement of existing wastewater treatment facilities. The potential of the existing plant site to be developed for future flows should be examined. This may be especially important when Highland Park and Hamtramck upgrade their collection systems.


BURTON
DAVISON
ELBA
LAPEER
ATTICA
MUSSEY
EMMET
KENOCKEE
CLYDE
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KIMBALL
PT HURON
GRAND BLANC
ATLAS
HADLEY
METAMORA
DRYDEN
ALMONT
BERLIN
RILEY
WALES
HOLLY
GROVELAND
BRANDON
OXFORD
ADDISON
BRUCE
ARMADA
RICHMOND
COLUMBUS
ST CLAIR
ROSE
SPRINGFIELD
INDEPENDENCE
ORION
OAKLAND
WASHINGTON
RAY
LENOX
CASCO
CHINA
HIGHLAND
PONTIAC
CHESTERFIELD
IRA
COTTRELLVILLE
WHITE LAKE
WATERFORD
PONTIAC
SHELBY
MACOMB
AVON
CLAY
COMMERCE
BLOOMFIELD
TROY
STERLING HGTS
HARRISON
CLINTON
MILFORD
BLOOMFIELD
LYON
NOVI
FARMINGTON HILLS
WARREN
SOUTHFIELD
LAKE ST. CLAIR
NORTHVILLE
SALEM
PLYMOUTH
LIVONIA
REDFORD
SUPERIOR
CANTON
DEARBORN
NORTH
YPSILANTI
VAN BUREN
ROMULUS
TAYLOR
BROWNSTOWN
HURON
AUGUSTA
SUMPTER
LONDON
EXETER
ASH
BERLIN

LEGEND:

- □ Detailed Facilities Plan Planning Area
- ▨ Interceptor Capacity Overview Planning Area

DETROIT
C262920

FINAL
PLAN OF STUDY AREA
JULY 1, 1976

# APPENDIX 11.10

## Public Hearing Comments and Responses to Review Agencies

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11-92

To Be Prepared Following

Hearing and Review